Concrete

Vol. 21 *Detroit, July, 1922* *No. 1*

The Economy of Field Control of Concrete

AS has been pointed out previously in these pages, it is impossible to regard the proposal of the Joint Committee to provide for the specification of concrete by strength as anything but logical. Unworkable as such a specification may seem under the field methods that have been built up by concrete contractors (and there appears to be so formidable an opposition to the form of Joint Committee Section 28 that it cannot be adopted), so much attention has been directed to the desirability and the ultimate economy and therefore necessity of designing concrete with more exact knowledge of what kind of concrete is to be produced, that it is only a matter of a little more time when the principle of the thing will be accepted and means found to make it workable.

The leading concrete contractors cannot be blamed for their opposition to the measure at the outset. It is only natural to resist a progressive step which will necessitate a change in field methods—a junking of field practice, painstakingly worked out to produce a maximum of quality under the conditions that have prevailed. Still, in spite of all the opposition, the more progressive contractors cannot overlook the possibility of putting themselves in the specially advantageous position of making workable field practice out of the knowledge of control of strength that has gradually been built up.

Progress in this direction is speeded up by such experiences as are reported in the article, "Controlling Quality of 400,000 cu. yds. of Concrete," by R. B. Young, in this issue. Especially is this true since Mr. Young is able to say: "The cost of the investigational work leading to the adoption of the method of proportioning and testing pursued at Niagara Falls, together with any additional cost of testing due to the methods followed, were more than offset by the savings which the methods permitted."

* * *

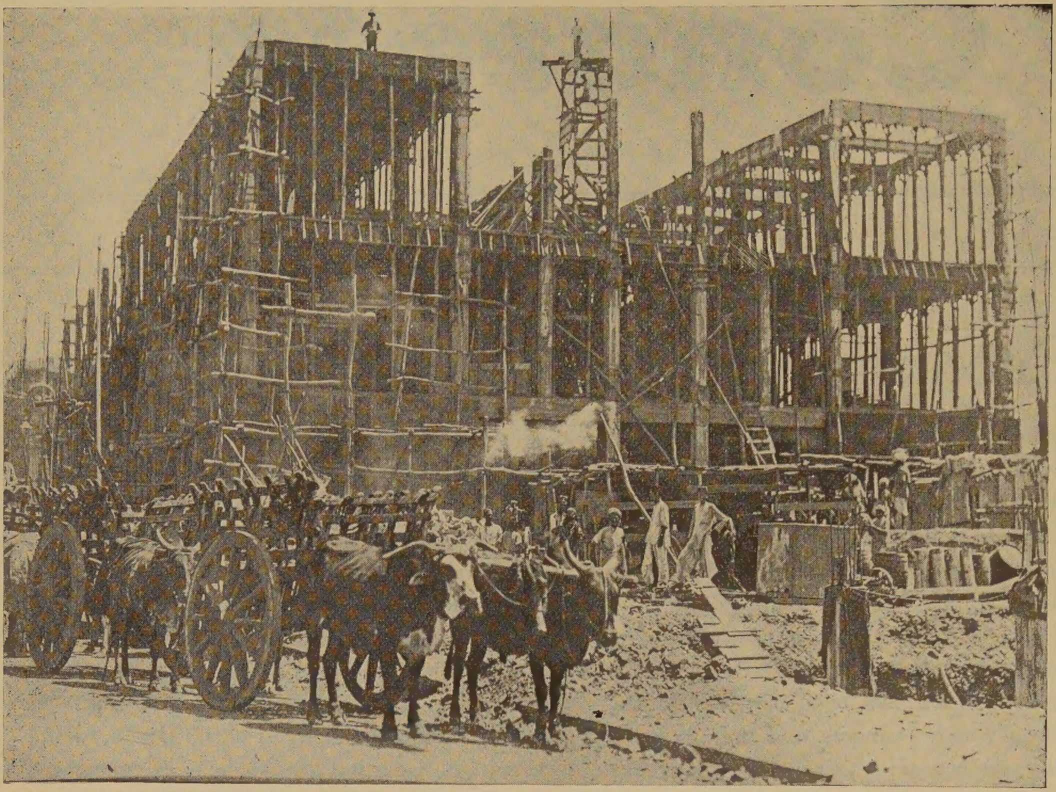
Cement and Cements of the Future

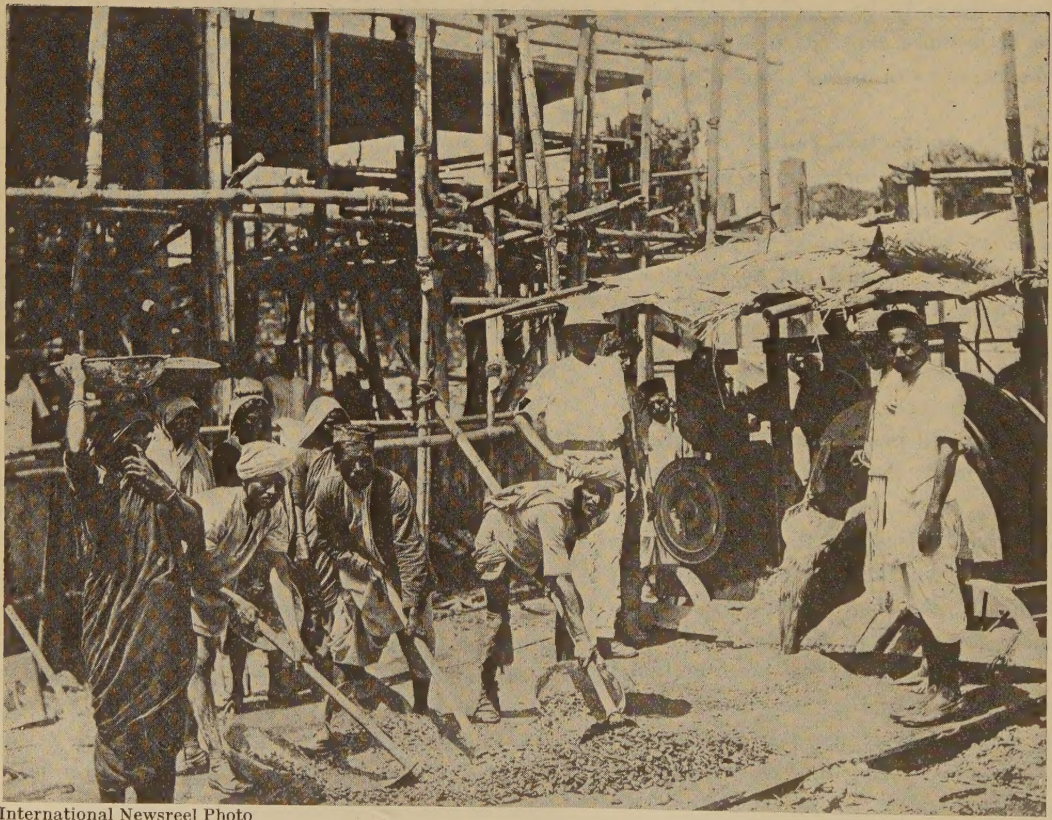
THE perfection of concreting will also be developed by a more progressive development of the binder. The cement people attach a good deal of importance to the American cement standard. Things are standard or not, depending on the rule adopted for measuring them. House cats and pole cats are in numerous respects alike. Go just so far with descriptions of the two and they are identical. A standard for cats could be drawn that would include them both. Nobody having had any experience with the two will insist they are alike. Nor are our standard brands of cement alike. The new American Concrete Institute Proceedings (Vol. 18), containing the discussion of the Joint Committee report, give the testimony of D. H. Dixon, of the Turner Construction Co., that 28-day tests of concrete cylinders made with eight different brands of cement in the New York market, showed 100% variation in strength. These differences were minimized by long-time tests, but the fact remains that portland cement covers a rather wide range of products.

This is not written in disparagement of this wide range. It is in disparagement of any tendency toward a smug satisfaction with our standards.

A variety of cements would be desirable—known, labeled varieties—not recognized under a misleading standard that is loosely enough drawn to put them all in the same category but differentiated by more finely drawn methods of test and measurement.

A good deal has been gained by the rallying of the cement interests around one standard, and the value of their cooperative study of the uses of cement in concrete is not to be underestimated. Knowledge the cement producers have helped us get in this direction is leading us to expect that they will shortly undertake, collectively perhaps, but probably by individual initiative, to solve the next problem with quite as much zeal as they have attacked the first. That next problem is the study and development of cement itself. The name "portland cement" should perhaps be only a broad classification. The development of the new French product—cement Fondu—whose quick-hardening characteristics make possible the building of bridges cantilever fashion, hanging the falsework of today's concreting on yesterday's hardened product—building an arch as though of steel from two sides until they meet at the center—such achievements inevitably have the effect of unsettling our smugness and opening the eye of imagination to new concrete marvels which are yet to be realized.





International Newsreel Photo

Modern Concrete Buildings Being Erected in Bombay, India, Are in Marked Contrast to the Old Wooden Buildings of the Ancient City—Japanese Carpenters Are Employed, Under English Architects and Engineers, with Native Labor

Natives, Both Men and Women, at One of the Concrete Mixers Are Shown in the Lower Picture Hoeing Up "the Mud" into Shallow Vessels, from Which the Mix Is Deposited in the Forms

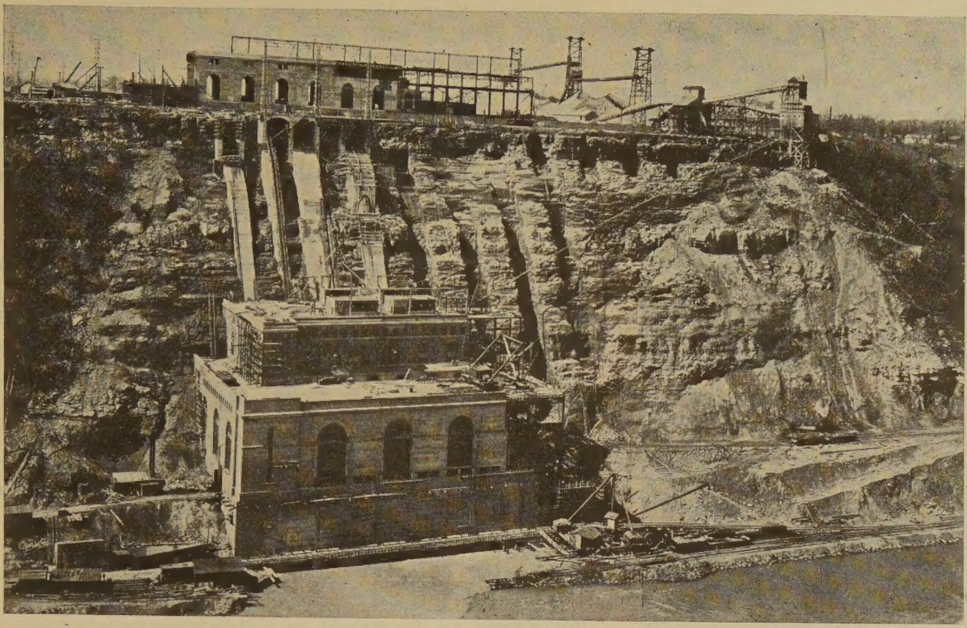


FIG. 1—POWER HOUSE AND SCREEN HOUSE UNDER CONSTRUCTION —MIXING PLANT AND AGGREGATE STORAGE UPPER RIGHT HAND CORNER — COMPLETE POWER HOUSE WILL EXTEND APPROXIMATELY TO WHERE SHOVEL AND CARS ARE, AT RIGHT OF POWER HOUSE

Controlling Quality of 400,000 Cu. Yds. of Concrete

BY RODERICK B. YOUNG
SENIOR ASSISTANT LABORATORY ENGINEER,
HYDRO-ELECTRIC POWER COMMISSION OF ONTARIO

> This article tells how many thousands of barrels of cement were saved, and the cost of concrete proportionately reduced by methods which set up a definite field control of the mix, with a view to obtaining specified strengths of concrete at 28 days.

Concrete of unusually uniform quality was obtained throughout the construction of the Queenston-Chippewa development of the Hydro-Electric Power Commission of Ontario, recently put into operation at Niagara Falls. In a period of 13 months 410,000 cu. yds. of concrete were placed from 21 different plants scattered along eight and one-half miles of canal. Using a very complete system of inspection, and methods which were developed in the field and in the laboratories of the Commission, it was found possible to control the strength and quality of this concrete and at the same time reduce the quantity of cement used below that normally required for similar classes of concrete.

The Queenston-Chippewa development diverts around the Canadian side of Niagara Falls a flow of approximately 15,000 sec. ft. The flow of the Welland River is reversed for four and one-half miles, after which the water is carried through a canal excavated in earth and rock to a power house at Queenston. The initial installation has a capacity of 275,000 h. p., while the ultimate capacity of the development will exceed 550,000 h. p. The canal is lined with concrete for the greater part of its length to an average height of 34 ft., while practically all of the structures are of concrete.

During 1920 concreting was in progress over the entire length of the canal, from seven stationary plants and fourteen traveling plants. The equipment used in these plants was that usually found on large jobs. One yard stationary mixers were used, charged through measuring hoppers from overhead bins. The concrete was placed both by chutes and by wet haulage. A one-minute mix was used, this being the net time all materials including water were in the mixer drum. All chutes were sloped at 2¾ to 1 or steeper, a 2½ to 1 slope being used whenever possible. The consistency used was wet enough to flow readily in the forms without segregation. No trouble was experienced in chuting this concrete.

All materials entering into the concrete were subject to rigid inspection and test. The principle was adopted that whenever possible inspection and testing of materials was to be carried out at the point of origin. In this way no material would get on to the work which could not be used at once if so desired. A small central laboratory was installed on the job for testing concrete and making analyses of the aggregates, and this was placed under the direction of the chief field inspector.

All cement shipments were sampled at the mills by a representative of the Commission, and either tested

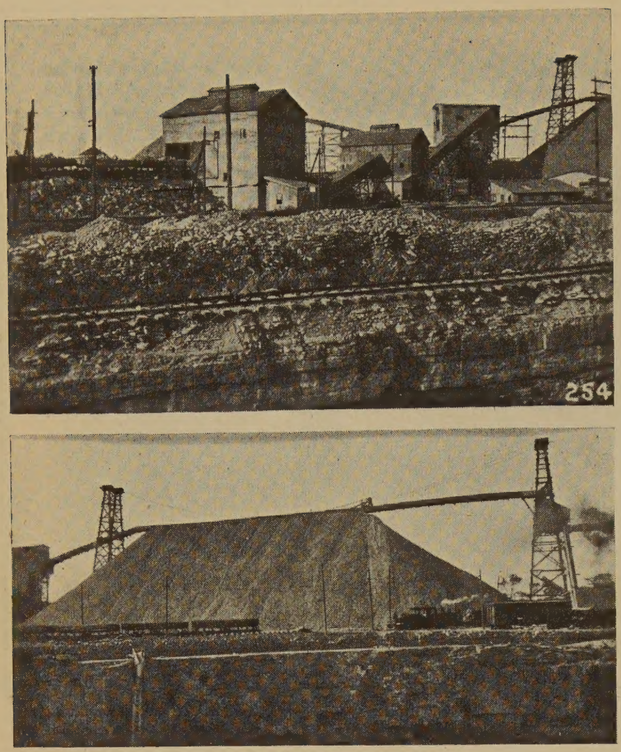


Fig. 2—Crushed Rock Storage, 160,000 cu. yds. in Pile—Crushing Plant Capacity, 3,000 cu. yds. per Day

there or at the Commission's laboratories at Toronto. A large part of the cement was "bin tested"; that is, it was sampled, tested and accepted before it left the mill. To make this possible, special bins were reserved at the mills for the exclusive use of the Commission. As these were filled, samples of the cement were taken from the conveyor and tested. Shipments were made only after the tests had shown the cement to be satisfactory, after which it was loaded as required under the supervision of a representative of the Commission resident at the mill. No cement was used until it had met the 7-day requirements of the specifications.

The aggregates used throughout the work were sand and crushed stone. The sand was obtained from two sources, a pit situated adjacent to the work and a deposit in Lake Ontario. Both materials were of excellent quality. The pit sand had an average surface area of 2,130 sq. ft., and the lake sand 1,680 sq. ft. per 100 lbs., which is equivalent to a fineness modulus of 2.7 and 3.2, respectively. The variation of the material as received was kept within limits fixed by the engineers and enforced by the inspectors situated at the points of supply. The pit sand was found to require about 10% more cement than the lake sand, to obtain concrete of the same quality. With the two sands being delivered to the job simultaneously, it required close attention on the part of the inspectors to maintain the proper proportions at each of the different plants.

The crushed rock was a dolomitic limestone from the canal excavation. It was screened to remove both oversize and dust, the product grading uniformly from ¼ in. to 2½ in., and containing an average of about 8% of screenings and dust, which, because of the nature of the rock and the fact that it was usually screened wet, could not be entirely eliminated. Some of the oversize was recrushed to pass a 1½ in. screen, and the product reserved for special locations where a finer aggregate was preferable.

Aggregates were inspected and tested at their source. Inspectors were placed at the sand pits, on the sand dredge, and at the loading plants. These inspectors were supplied with sieves and were required to report daily on the quality of the material shipped by them. In the case of the pit sands, particular attention was paid to the stripping of the deposits. The crushing plant was given periodic inspection and any conditions found affecting the quality of the product were immediately remedied.

Four classes of concrete were used on this work. They were called, for convenience, A, B, C, and D. Class A was required to be of such quality as to have a minimum compressive strength of 2,500 lbs. per sq. in. at 28 days, when tested in accordance with the standard methods of the Commission. Classes B, C, and D were required to have minimum compressive strengths of 2,000, 1,500 and 1,000 lbs. per sq. in., respectively, under the same conditions. The methods of testing used were essentially those standardized by the American Society for Testing Materials.

Proportions for the different classes of concrete were set by the chief inspector and were determined by a modification of Edward's surface area method of proportioning as developed in the laboratories of the Commission. No attempt will be made here to describe the theories on which the methods were based, a discussion of these having already been published in Concrete. In applying the method a preliminary series of tests are made on the materials to be used. These establish the relation between water-cement ratio and strength, and between cement content and surface area, for one consistency of mixture. From this information, and from the mechanical analyses and weights per cubic foot of the materials as used in the field, it is possible to set accurately the quantities of cement, fine aggregate, coarse aggregate and water which will be required to give a concrete mixture of the desired consistency and strength.

On the work described, experimental studies of the concrete making properties of the aggregates were made upon each of the two principal sands used. Proportions were originally calculated from these data, but control of the quality was obtained almost entirely by maintaining an approximately constant ratio between the water and cement in the mixtures. This was, in effect, the same as recalculating the proportions for each change in grading or consistency, but was simpler and did not require any special knowledge of the theories of proportioning on the part of the inspectors. The inspectors on the various plants were told the maximum quantity of water which could be used for each bag of cement in the batch, for each of the different classes of concrete. In no case were they to exceed this without authority from the chief inspector. If, because of a change in the gradation of the aggregate supplied to any plant, the mixtures obtained were too dry, they were allowed to change the proportions by adding cement and water to the aggregate until a mixture of the required consistency was obtained, always keeping the ratio of cement to water within the maximum for that class of concrete. If, for any reason, a wetter consistency was required than was ordinarily used, the same procedure was followed until the desired degree of wetness was obtained. On the other hand, if the aggregates used were coarser than before, or if a drier consistency could be used, the reverse operation was carried out and cement and water left out of subsequent batches.

One or more inspectors were placed at each of the concrete plants. Their duties were those usually required of a concrete inspector. They were, however, empowered to adjust the proportions set by the chief inspector in the manner just described. They were also required to take from the forms, periodically, samples of the concrete being placed and to prepare these for testing.

The field laboratory was equipped with a 100-ton hydraulic compression machine of simple and inexpensive design, and the usual equipment of sieves, scales and miscellaneous apparatus for testing aggregates. Space was also provided for the storage of concrete test cylinders during the curing period.

These methods were in their application both effective and economical. In Table 1 are given complete results from the tests of concrete placed on the power house and canal lining during the period of maximum production, May, June and July, 1921. These results are from ten plants, each supervised by an inspector. Each result is from a test of an individual specimen, the other specimen taken being broken for advance information at the age of seven days. Sand from both major sources was in use on all the plants during this period. When the conditions under which concrete is manufactured in the field are considered, the results show that the product obtained on this job was remarkably uniform. On the entire job, from November 1, 1920, to November 1, 1921, 74% of the test cylinders either met or exceeded the specification requirements, while 87% either met them or did not fall below them more than 200 lbs. per sq. in.

Not only was concrete obtained which met the quality requirements of the Commission, but there was a material reduction in the quantity of cement used to obtain these results over what would ordinarily be estimated for concrete of equal quality. This is shown in Table 2. For comparison is given the quantity of cement required per cubic yard for concrete of equal quality as stated by Taylor and Thompson in their treatise, *Concrete—Plain and Reinforced,* together with the figures estimated by the Commission from the results of their investigations, using sand and crushed rock aggregates similar to those on this work. The figures indicating the requirements as given by Taylor and Thompson were lower than those of any other authority consulted. On the quantity of concrete placed, these differences show an actual saving of 56,650 bbls. upon the figures of Taylor and Thompson, or of 35,490 bbls. as compared with the Commission's estimate.

TABLE 1

RESULTS OF COMPRESSION TESTS ON FIELD CYLINDERS, CHIPPEWA-QUEENSTON POWER DEVELOPMENT POWER HOUSE—MAY 1ST TO JULY 31ST, INCLUSIVE

Class B

Date Taken	Nominal Proportions by Volume	Compressive Strength 28 days—Lbs. per sq. in.
May 9	1:1.83:3.66	2,655
May 16	1:1.83:3.66	2,435
May 19	1:1.83:3.66	2,322
May 26	1:1.83:3.66	2,680
May 30	1:1.83:3.66	2,449
June 2	1:1.4 :4.4	2,180
June 4	1:1.83:3.66	2,443
June 7	1:1.83:3.66	2,140
June 16	1:1.83:3.66	2,775
June 21	1:1.83:3.66	3,750
June 23	1:1.83:3.66	2,785
June 29	1:2.44:4.88	1,927
July 1	1:1.83:3.66	2,812
July 16	1:1.83:3.66	2,280
July 20	1:1.83:3.66	2,324
July 30	1:1.83:3.66	2,398

RESULTS OF COMPRESSION TESTS ON FIELD CYLINDERS—CHIPPEWA-QUEENSTON POWER COMMISSION DEVELOPMENT POWER HOUSE, MAY 1ST TO JULY 31ST, INCLUSIVE

Class C

Date Taken	Nominal Proportions by Volume	Compressive Strength 28 days—Lbs. per sq. in.
May 2	1:2.5 :5	1,253
May 5	1:2.5 :4.25	1,970
May 11	1:2.44:4.88	1,728
May 14	1:2.44:4.88	1,725
May 28	1:2.44:4.88	1,855
June 9	1:2.44:4.88	1,825
June 11	1:2.44:4.88	2,198
June 14	1:2.44:4.88	2,345
June 18	1:2.44:4.88	2,420
July 5	1:2.44:4.88	1,802
July 8	1:2.44:4.88	1,941
July 12	1:2.44:4.88	1,703
July 14	1:2.44:4.88	1,304
July 26	1:2.44:4.88	2,030
July 28	1:2.44:4.88	1,027

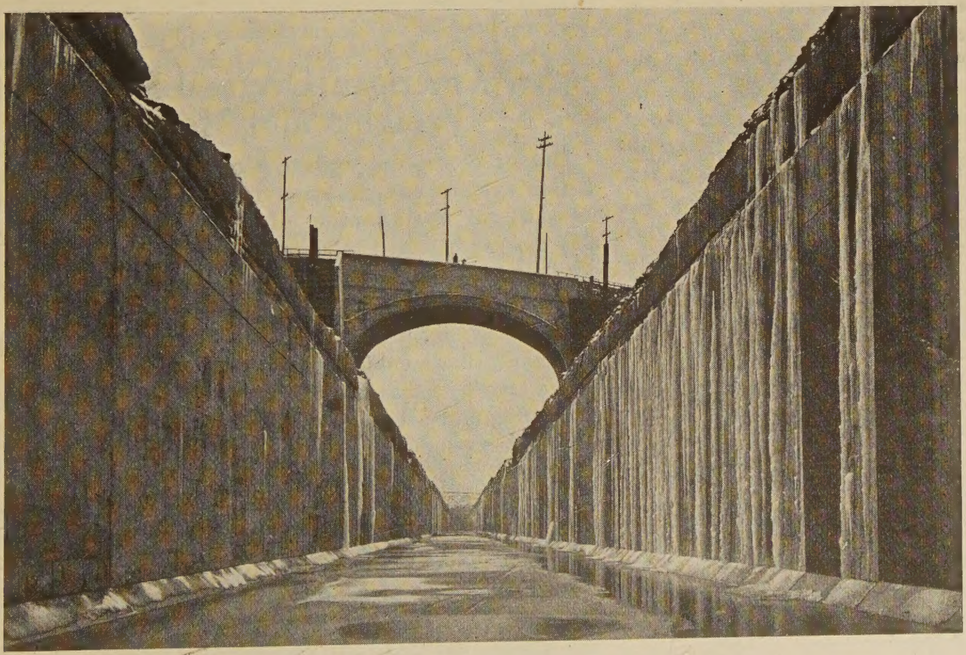


FIG. 3—SECTIONS OF CANAL IN ROCK, WITH CONCRETE ARCH RAILWAY BRIDGE IN FOREGROUND

The total cost of all investigational work leading to the adoption of the method of proportioning and testing followed, together with the cost of the field testing re- alone. At the same time concrete of exceptionally high quired was but a fraction of the amount saved in cement and uniform quality was obtained. The laboratory equipment used represented an investment of less than $1000 and only one additional man was required to carry out the testing. The same number of inspectors were used as would have been necessary in any case where the work was subject to inspection. Excluding the cost of the strictly research work which is of general application to all concrete work of the Commission, the additional cost directly chargeable to the methods followed would be less than 1/10 of 1 per cent of the cost of the concrete.

Sir Adam Beck is chairman of the Commission, for which Fred. A. Gaby is chief engineer, H. G. Acres, hydraulic engineer; T. H. Hogg, assistant hydraulic engineer, and M. V. Sauer, engineer of design. The work is in charge of H. G. Acres, under whom G. H. Angell is general superintendent, and A. C. D. Blanchard chief field engineer.

TABLE 2

QUANTITY OF CEMENT PER CU. YD. OF CONCRETE ESTIMATED AND USED BY THE HYDRO-ELECTRIC POWER COMMISSION OF ONTARIO, QUEENSTOWN CHIPPEWA DEVELOPMENT

Class	Minimum Compressive Strength at 28 days—lbs. per sq .in.	Taylor and Thompson "Concrete—Plain and Reinforced"**	Barrels of Cement per cu. yd.	
			Estimated by H. E. P. C.	Actually used by H.E.P.C.
A	2,500	1.91	1.75	1.55
B	2,000	1.51	1.40	1.36
C	1,500	1.24	1.16*	1.12
D	1,000	1.11	0.99	0.91

*For canal lining estimate was 1.22 bbls. per cu. yd.

**For crushed rock concrete, using run of crusher with dust removed, which corresponds to conditions on Queenston-Chippewa Development.

TABLE 3

RESULTS OF COMPRESSION TESTS ON FIELD CYLINDERS, CHIPPEWA-QUEENSTON POWER DEVELOPMENT CANAL LINING PLANTS, MAY 1ST TO JULY 31ST, INCLUSIVE

RESULTS FROM LINING AND PAVING PLANTS INCLUDED..........

Class C

Date Taken	Nominal Proportions by Volume	Compressive Strength 28 days—Lbs. per sq. in.
May 4	1:2.5 :5	2,935
May 6	1:2.5 :5	2,687
May 6	1:2.5 :5	1,555
May 9	1:2.5 :5	3,066
May 9	1:2.5 :5	1,673
May 11	1:2.5 :5	1,910
May 13	1:2.8 :4.4	2,050
May 14	1:2.5 :5	1,877
May 16	1:2.8 :4.4	1,633
May 16	1:2.5 :5	1,077
May 18	1:2.8 :4.4	1,843
May 18	1:2.4 :4.4	1,827
May 19	1:2.5 :5	1,865
May 20	1:2.8 :4.4	1,820
May 20	1:2.5 :5	1,930
May 23	1:2.5 :4.16	1,743
May 23	1:2.5 :5	1,292
May 25	1:2.5 :5	1,922
May 25	1:2.5 :5	1,868
May 27	1:2.5 :5	2,445
May 28	1:2.5 :5	2,145
May 30	1:2.8 :4.4	1,845
June 1	1:2.5 :5	1,865
June 2	1:1.33:4.06	1,845
June 3	1:1.28:4.44	1,886
June 4	1:2.5 :4.8	1,688
June 4	1:1.45:4.36	1,720
June 6	1:3.12:6.25	1,593
June 6	1:2.5 :5	1,428
June 6	1:2.5 :5	1,488
June 6	1:3.12:6.25	1,247
June 7	1:1.33:4	3,294
June 8	1:3.12:6.25	1,912
June 8	1:1.83:3.83	2,425
June 8	1:2.5 :5	2,853
June 8	1:2 :4	2,396
June 10	1:2.8 :4.4	2,482
June 10	1:2.2 :4.6	3,175
June 11	1:2.5 :5	1,892
June 12	1:2.2 :4.8	1,594
June 13	1:2.5 :5	1,782
June 14	1:2.5 :4.8	2,403
June 14	1:2 :4.8	1,320
June 15	1:2.5 :5	1,677
June 16	1:2.5 :5	2,165
June 16	1:2.5 :4.8	2,755
June 17	1:2.8 :4.4	2,360
June 19	1:2.5 :4.8	2,310
June 19	1:2.2 :4.8	1,797
June 20	1:2.5 :5	1,710
June 21	1:2.2 :4.8	1,912
June 21	1:2.2 :4.8	1,840
June 22	1:2.5 :5	1,652
June 23	1:2.2 :4.4	1,590
June 24	1:2.2 :4.8	1,780
June 25	1:2.2 :4.4	2,935
June 26	1:2.5 :4.8	1,810
June 29	1:2.2 :4.2	1,720.
June 29	1:2.77:5.55	1,450
June 30	1:2.5 :5	1,548
July 1	1:3.11:4.88	1,768
July 2	1:2.2 :4.4	2,071
July 4	1:3.11:4.88	1,607
July 5	1:2.2 :4.2	1,892
July 5	1:3.12:6.25	1,390
July 6	1:2.77:5.55	1,921
July 7	1:2.2 :4.4	2,025
July 8	1:3.11:4.88	1,472
July 11	1:2.77:5.55	1,412
July 12	1:2.2 :4.2	1,152
July 13	1:2.77:5.55	1,530
July 14	1:2.5 :5	1,782
July 15	1:3.11:4.88	2,447
July15	1:2.2 :5	2,012
July 20	1:2.2 :5	2,605
July 20	1:2.77:5.55	2,178
July 20	1:2.44:4.88	1,414
July 20	1:2.77:5.55	1,397
July 22	1:2.77:5.55	877
July 22	1:3.11:4.88	1,513
July 25	1:2.77:5.55	2,549
July 26	1:2.5 :5	1,613
July 27	1:2.5 :5	1,515
July 27	1:3.11:4.88	1,495
July 27	1:2.44:4.88	1,435
July 29	1:2.77:5.55	1,445
July 30	1:2.5 :5	1,603
July 30	1:2.5 :5	1,559
July 30	1:2.77:5.55	1,399

Class D

Date Taken	Nominal Proportions by Volume	Compressive Strength 28 days—Lbs. per sq. in.
May 13	1:3.12:6.25	1,663
May 30	1:3.12:6.25	517
June 2	1:2 :5	1,158
June 14	1:2.75:5.5	2,018
June 17	1:2.75:5.5	1,692
June 20	1:2.77:5.55	1,905
June 22	1:3.11:4.88	1,632
June 24	1:3.11:4.88	2,365
June 27	1:2.77:5.55	2,165
July 14	1:3.12:6.25	990
July 19	1:3.57:7.14	814

An American Decimal System of Weights and Measures

Out of the recent agitation over the adoption of the metric system has grown a movement, led by Samuel Russell, for the adoption of a new system of weights and measures which is claimed to have none of the disadvantages of the metric and English systems and would not be difficult of adaptation to industry.

In a bill at present before Congress, Mr. Russell points out that a cubic foot of water weighs 1,000 ounces, which affords a means of tieing up linear with volumetric quantities and giving a volumetric definition to weights. This interconnection is one of the chief arguments for the metric system, but the decimal system has not the degree of inapplicability of the metric system, because the English system, as used at present in engineering industrial work, is decimalized to a considerable extent.

Mr. Russell's exposition of his system is set forth at length in a pamphlet issued by the Government Printing Office, entitled "An American Decimal System of Weights and Measures."

How I Built Up a Septic Tank and Burial Vault Business

By Roy C. Jarvis,
Port Huron, Mich.

Fifteen years ago I started in the concrete burial vault business in this town by making a contract giving me a set of molds and control of the patent rights on a good concrete vault in my territory.

I made up some vaults, advertised them, talked them, used my friends and did my level best to create a demand for this type of vault, in the face of slate, steel and brick competition and the usual human inertia which makes people slow to investigate a new idea. In those days concrete burial vaults were new in this part of the country. They were less widely known even than the concrete septic tank is today.

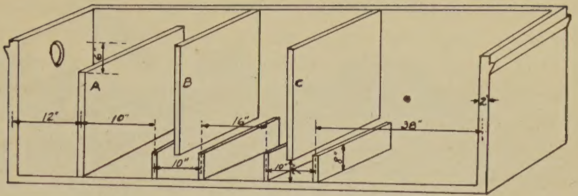
The sledding was hard. At the end of six months I had all my vaults in my yard, I had my molds, a copy of my contract and a headache. No orders, no money and only a vacuum where my enthusiasm had been. Like many another young business man in such a situation I thought I was at the end of my rope—broke, discouraged. I shipped the molds back, got a cancellation of my contract and started feebly the manufacture of concrete block.

Within two months I started to get orders for burial vaults. I sold those I had originally made. The idea grew upon me that I had quit too soon—that the sales I was making were the logical result of the work I had done—a result that I had awaited with too little patience.

The orders for vaults soon exceeded my supply. One undertaker was well sold on them and easily sold his clientele. He asked for more vaults. Other undertakers expressed an interest. The cemetery people watched the performance of the vaults in use. People began to talk about the new kind of vault.

So I bought another set of molds, making a little different design of vault, and resumed the manufacture of the product. The demand continued to increase and with intelligent, tactful selling effort I have built this department of my business up to a volume of from 125 to 135 vaults per year. That's the history of the burial vault business with me and the moral will be found in the third and fourth paragraphs of this story.

In 1917 I designed a reinforced concrete septic tank, large enough for the ordinary dwelling or country school, light enough to be cast in one piece with a separate lid and transported and placed much as burial vaults are handled. I perfected steel molds for making the one size, No. 10, and the sketch shows the design of this tank.



From Sketch to Show Design of Jarvis Septic Tank

It will be noted that the tank is essentially rectangular in shape with two baffle boards A and B reaching the top but not reaching the bottom. Each of these divisions is flanked by two shallow baffle boards extending from the tank bottom up slightly above the level of the bottom of the large boards. Sewage enters the tank and is acted upon by the bacteria formed and living in the scum at the water level. The baffle boards simply prevent the disturbance of this scum, which should be kept intact. The contents flow out of the tank through the gravel filled compartment between division C and the end wall of the tank at the outlet end.

The tank is cast right-side up, the bottom being 2½ in. thick reinforced with 24 gauge ¾-in. mesh Northwestern expanded metal centered. Side walls are 2 in. thick, reinforced the same way. The inside forms provide properly spaced grooves on the inside wall surfaces and when the inside forms are removed, forms for the baffle boards and partition are set up and poured, the ends bonding in the grooves. All interior partitions are ⅞ in. thick. The lid is convex on top and concave on the under side, is reinforced with expanded metal and is 3 in. thick along the center line. The top of the completed lid reveals four steel rings formed by 3/16 in. rods bent as per sketch (Fig. 2), the hook end of each being placed toward the end of the lid and the longitudinal members being below the reinforcing. A hole is punched in the reinforcing to let the ring part through. The lid top is finished with a wood strike-off board as shown (Fig. 2).

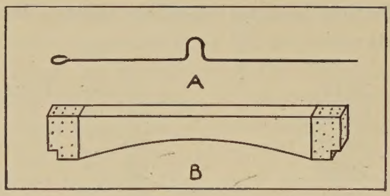


Fig. 2

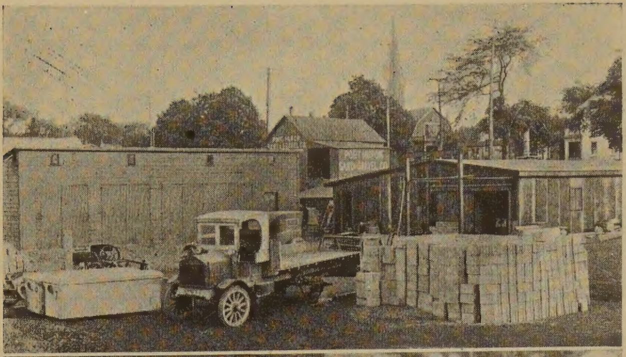
Now that's the tank I originally designed in 1917 and the design is practically the same today. That size of tank, the No. 10, holds 500 gallons of water. We had some trouble with our first lids—they weren't strong enough but when that was corrected, every tank made good. Many of them have been opened and all were found in the best condition. There is no originality in my system of sewage disposal. I have simply followed the accepted rules of septic action and have provided a suitable receptacle for encouraging and protecting that natural process.

As time went on my tanks became extremely popular and I noted a demand for tanks of less capacity. I now furnish three sizes:

Number	Capacity	Weight	Selling Price
10	500 gal.	3600 lbs.	$125.00
8	400 gal.	2800 lbs.	100.00
6	300 gal.	2400 lbs.	75.00

The weight figures include lids. The lid weight is about 25% of the total weight.

Building a demand for these tanks was slow business at first but I had learned from my burial vault experience. I have actually put in less-selling effort on the septic tanks than I did on the burial vaults. I ought



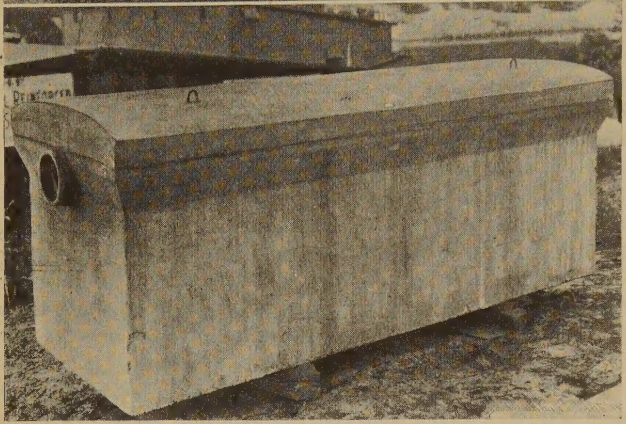


FIG. 3—THE JARVIS PRODUCT PLANT YARD
FIG. 4—A COMPLETED SEPTIC TANK

to put on more selling pressure and intend to but right along there has grown a steady demand for these tanks, each installation leading to other sales. My sales have run like this:

1917	7	No. Tens
1918	15	" "
1919	20	" "
1920	25	" "
1921	40	" "
1922 (First 5 mo.)	2	" "
	2	" Eights
	18	" Sixes

It will be seen that the No. 6 is my best seller. To make a No. 6 tank it takes 5/8 yd. of gravel passing 1/4 in. mesh, 8 yds. reinforcing fabric and 7 sacks of cement.

I sell these tanks over a 20 mile radius, using two Reo 2-ton trucks for the delivery of these and other products. My prices include setting the tank in a prepared hole, top of tank generally resting within one foot of grade, they allow easy access. The tank lid seals perfectly, providing the airtight condition necessary for proper septic action, yet removal of the lid is comparatively easy. If work between the tank and the house or beyond the outlet of the tank is required, we do trenching, tile-laying, etc., on a cost-plus basis.

The tremendous amount of educational work done by agricultural colleges, state health departments and various federal government agencies is producing results. People are taking a real interest in sanitary measures. In communities without sewer facilities, septic tanks are favorably known and we believe this part of our business has by far the most prosperous future ahead of it.

I believe that it will be only a matter of a few years when all the sewage in cities and towns will pass through individual septic tanks into the storm sewers, thus, eliminating sewage entering any streams.

The Cement Industry, the Trial, and the Public

BY EDWIN C. ECKEL

The trial of the Eastern cement manufacturers ended, to the surprise of almost everyone concerned, in a disagreement by the jury. This implies the probability of a new trial; it also implies that, until such new trial be held, the defendants, both individuals and corporate, will rest under a cloud of more or less density. That of itself is unfortunate, for the relations between the American cement industry and the public which it serves, have not been, of recent years at least, entirely satisfactory; and a clean acquittal in the recent trial would have aided in establishing more satisfactory relations between the cement manufacturer and the cement consumer.

In view of these conditions it will be profitable to consider the recent trial a little more broadly than was possible while the case was still in progress, and try to come to some conclusions as to what really was proven, what was disproven, and what was left uncertain. It is possible to do this with some degree of certainty, for in spite of the final jury disagreement there really were some things made clear enough to the average observer.

THE CEMENT TRADE ASSOCIATIONS

All of the defendant corporations in the recent trial were members of the Cement Manufacturers Protective Association, which covered, in its activities, the northeastern part of the country. Similar associations exist in various other portions of the country; and at present all or most of these are under indictment, in cases more or less closely like the one that has just been tried. Taken together, these trade associations cover the United States pretty completely.

In all cases these trade associations carry on certain activities which in themselves appear to be harmless and even meritorious. They collect statistics as to cement production, stocks on hand and commitments—and none of these things is of itself harmful to the industry or to the public. They also gather statistics as to the contracts entered into by member companies on specific jobs, and here the matter becomes less clear. The contract figures include quantities, location and prices.

Everything that has so far been stated is a mere matter of record, accepted as such by both sides in the recent case. The Cement Manufacturers Protective Association and other associations of similar type do exist; their membership is and has long been a matter of public information; and their general lines of activity are and have been known to cover the items above noted. No one seriously questions the utility of accurate statistics in the successful conduct of any business; and there are other activities in which competitors can helpfully cooperate, without damage to the public.

The contention of the Government was, not that the collection of statistics was harmful or criminal *per se*, but that these data had been put to unlawful uses, and that the real object of the trade associations was to fix prices by agreement. With this contention in mind we can take up each line of activity separately, and see how far the case went to prove or disprove the Government contention.

THE CLEARING OF THE PORTLAND CEMENT ASSOCIATION

Before doing this, however, we may turn for a moment to one of the few really definite and clear results of the trial. This, fortunately for the cement industry and for the public in general, was the clearing of the National Portland Cement Association from any suspicion of having been a party to any of the practices to which the Government objected.

During the early stages of the trial, when the Government seemed to be reaching out in various directions for possible lines of proof, there was considerable stress laid upon the fact that all the defendant corporations, indicted as being members of the Cement Manufacturers Protective Association, were also members of the national or Portland Cement Association. There seemed to be some danger that in the course of these wanderings confusion might arise as between these two associations. Fortunately this danger was removed by the Government itself, for in the closing portions of the case Judge Fowler, one of the government attorneys, took occasion to contrast the legal and beneficent activities of the Portland Cement Association with what he claimed were the illegal and harmful activities of the local trade association.

This result is fortunate, for it would have been a serious blow to the progress of cement if a cloud had rested upon the Association which is doing most to further the use of cement and to improve technical practices in such utilization.

THE STANDARDIZATION OF TRADE PRACTICES

Recurring to the immediate case, we may recall that the Government claimed, in the indictment and in its opening summary, that one of the means by which price control had been secured was the unification of certain trade practices. It claimed specifically that the defendant companies had arrived, by agreement, at common practice with regard to dealers, to bag allowances, to discounts.

Of these charges one was obviously frivolous, for everyone knows that the prices charged for cement sacks, and the allowances consequently made for their return, exactly cancel each other. There is no possible way, therefore, by which the bag prices could have any effect on the real net price of cement. But the defendants went beyond this simple disproof, and proved that the companies had, on balance, an actual loss on their bag accounts.

The charges as to maintenance of dealers lists, with the suggested charge that there were, essentially, blacklists maintained, would be very serious indeed if there had been the slightest proof of such practice. But as a matter of fact this too collapsed; it was proven that several of the larger companies had private lists of dealers, and no witness even suggested that he had been blacklisted or had ever heard of such a thing occurring.

THE QUESTION OF PRICE FIXING

The most serious charge, of course, was that the defendants had by agreement fixed prices at excessive levels. This charge was not proven at any time in the trial; it was in part very clearly and emphatically disproven. It will pay to separate its two component elements; and see how each fared in the trial.

First, as to the charge of price agreement itself: The Government proved that over long periods there was substantial uniformity in the prices charged for cement by the different companies; and from this uniformity deduced the claim that it must have arrived by agreement. The defense pointed out that sugar, copper, salt, cotton, wool, bread, stocks and many other standardized commodities had the same habit of reaching substantial uniformity of price in the same markets. The Government had of course no direct proof that an agreement did exist; and unfortunately it did not even have a clear idea as to how the alleged agreement operated. That was perhaps the weakest point in the government case, and it happens to be important. For the defense *did* prove that the defendants had not split their profits, or allotted quotas, or divided territory. Since any agreement must have provided for one of these three things, the Government proof is obviously faulty. Until some clever government attorney can think out a proper reply to this argument of the defense we must accept the fact that the charge of agreement is not proven and not proveable.

Second, as to the actual level of prices. The government had claimed that cement prices were excessive during the period 1916-1921; it was proven from government statistics that cement prices had, on the contrary, advanced far less than had the prices of other commodities. As extra disproof, the defense showed that cement prices had in fact not advanced as fast as the costs of cement manufacture. This part of the government claim, being based on a hopeless and demonstrable error of fact, can be regarded as dead in the future.

THE VERDICT, THE INDUSTRY AND THE PUBLIC

The case of the Government was inherently difficult, for of course direct proof in a matter of this kind is hard to obtain. The charges that were made were in many instances clearly disproven by the defense. Finally, the element of personal appeal was altogether lacking; there was not a single witness—engineer, contractor or dealer—put on the stand by the Government who testified or even suggested that his business had suffered in any way from the activities of the defendants.

Under these circumstances a prompt acquittal might fairly have been expected, even though portions of the charges had been left not proven rather than disproven. But as a matter of fact what came was a long deliberation by the jury and a final disagreement. It is clear that if a jury can divide evenly after hearing a case of this sort, whereas I have said direct proof was nonexistent and the indirect proof offered very weak, the disagreement must be based on general suspicion rather than on cold logic.

And that, it seems to me, is a thoroughly disturbing feature of the whole matter, so far as the relations of the cement industry with its public are concerned. As matters stand now, a large fraction of that public is suspicious of the cement manufacturers, while a smaller but important fraction is definitely hostile. It is obvious that even acquittal on a re-trial will not suffice to clear away these feelings of antagonism and to re-establish the friendly relations that should exist between a great industry and the consumers of its product. Yet such re-establishment is probably the chief problem which confronts the American cement industry today, and it will be a benefit to the public as well as to the manufacturer when it is accomplished.

Tables and diagrams that demonstrate in a striking manner the advantage to the farmer of having and using a silo, together with a good deal of valuable information on concrete stave silos, and the sizes needed for various herds, is included in a new publication of the Portland Cement Association, *Concrete Stave Silos*. This booklet is 6 by 9, and contains 18 pages.

Characteristics of Concrete Brick Masonry

By Herbert A. Davis
Engineer of Tests, Brooklyn Crozite Brick Corp.
Brooklyn, N. Y.

The necessity of fundamental data on the relation between the physical properties of wet mixed concrtee brick and the properties of concrete brick masonry to serve as a means of judging the consistency of present specifications as applied to concrete brick and to furnish the foundation for future specifications was recognized.

To supply in part at least this lack of fundamental data, tests of some 45 concrete brick piers, composed of wet mixed concrete brick of 13 different concrete mixtures, were built and tested for compressive strength.

For comparison, tests were made of 12 piers built in the same manner of three brands of Hudson river clay common brick, purchased in the local market.

At the same time the compressive strength, transverse strength and absorption of the individual brick of the various types were made.

All tests were made in the Civil Engineering Testing Laboratory of Columbia University by members of the University staff.

Representatives from the Bureau of Buildings of the various boroughs of New York City cooperated by inspecting the making of the concrete brick, building of the piers and the making of the tests.

All concrete brick were wet mixed or wet process, and were made at the plant of the Brooklyn Crozite Brick Corp., Brooklyn, N. Y. (For description of this plant and this process for making concrete brick, see the *Engineering News-Record,* January 27, 1921, and Concrete, February, 1921.) The proportions are by volume and the consistency of the resulting concrete was maintained practically constant for all mixes.

All the piers were built at Columbia University by a bricklayer and helper, in the usual manner. The brick were laid in a mortar of 1 part portland cement to 3 parts sand, and in accordance with plan in Fig. 1 the joints being from ⅜ in. to ½ in. in thickness. All piers were approximately 12 in. by 12 in. by 40 in. high, and consisted of 15 courses of brick. Three piers of each type of brick were built and tested.

Physical Tests of the Aggregates Used in Various Concrete Brick

Aggregate	—Mechanical Analysis, % Passing— Sieve							Weight per cu. ft. as Used Lbs.
	¼	No. 6	No. 10	No. 20	No. 40	No. 60	No. 100	
Sand	99.0	94.5	87.5	67.5	33.8	11.5	2.0	85
Hard coal steam cinders	95.0	63.2	44.6	27.2	17.6	12.5	9.4	46
Limestone screenings	98.6	82.0	61.5	45.1	38.2	32.8	24.6	110

Tests of Brick, Mortar, and Piers

The different types of concrete brick included in these tests were made to give a wide range in the results, and it should not be interpreted that brick of all the various mixtures are being manufactured commercially. Each result is the average of tests of 5 individual brick, the compressive strength was determined on whole brick tested flatwise, the transverse strength was determined on brick tested flatwise, on 7-in. span, for the absorption tests the brick were dried to constant weight, and the absorption obtained in 48 hours determined. Age of all concrete brick when tested, 60 days.

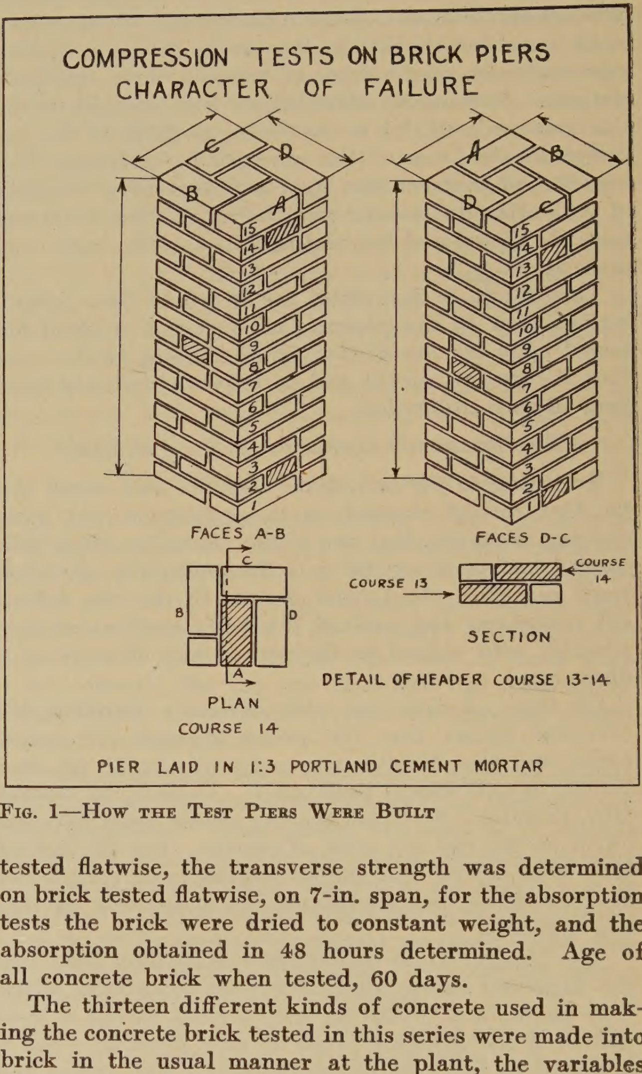


Fig. 1—How the Test Piers Were Built

The thirteen different kinds of concrete used in making the concrete brick tested in this series were made into brick in the usual manner at the plant, the variables that distinguished these concretes were variation in the brand of cement, variation in the cement content, and variation in the kind of aggregates used.

At the time of building the piers, three 3-in. cubes of samples of mortar being used were made and tested at the time of testing the piers, at which time the mortar was from 30 to 35 days old. The piers were built when the concrete brick were approximately 30 days old and tested from 30 to 35 days after being built.

Three special piers were built of a mixture of concrete bricks No. 77 to No. 88, the different types of brick being distributed throughout the piers.

Likewise three special piers were built of a mixture of brands B and C clay bricks.

Illustrations from photographs show the character of failure of brick piers of the various kinds, and the cones from different piers of concrete brick that indicate the failure of the masonry was similar to monolithic concrete. It was noted that after failure the bond between the concrete brick and mortar of joints was excellent, while in the case of clay brick piers after failure the brick were easily separated from the mortar.

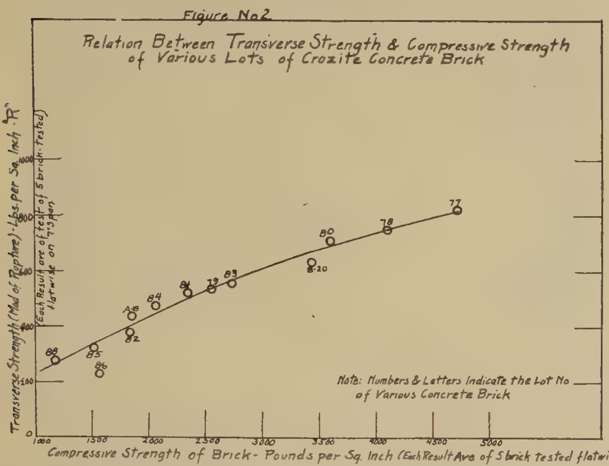


Fig. 2—Relation Between Compressive Strength and Transverse Strength of Concrete Brick of Various Mixtures

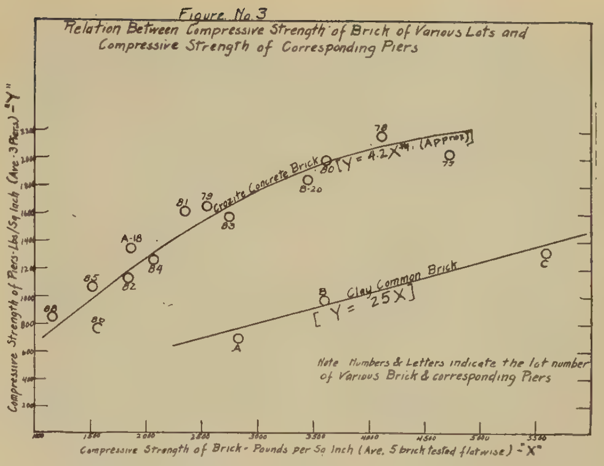


Fig. 3—Relation Between Compressive Strength of Brick and the Compressive Strength of the Piers

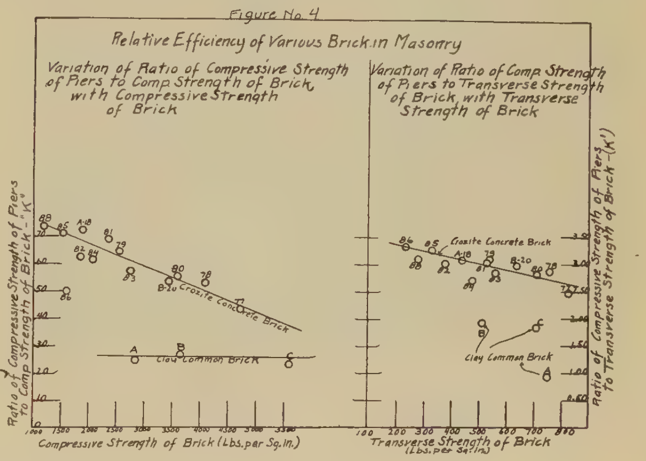


Fig. 4—(See Text)

Studies of Results

Fig. 2 shows graphically relation between compressive strength and transverse strength of the concrete brick of various mixtures. Fig. 3 shows relation between the compressive strength of various brick and the compressive strength of the piers built of them. Fig. 4 shows the variation of the ratio (K) of the compressive strength of piers to compressive strength of brick of which it is composed, with the compressive strength, of brick. Likewise the variation of the ratio (K1) of the compressive strength of pier to transverse strength of brick composing it with the transverse strength of brick.

Summary of Results

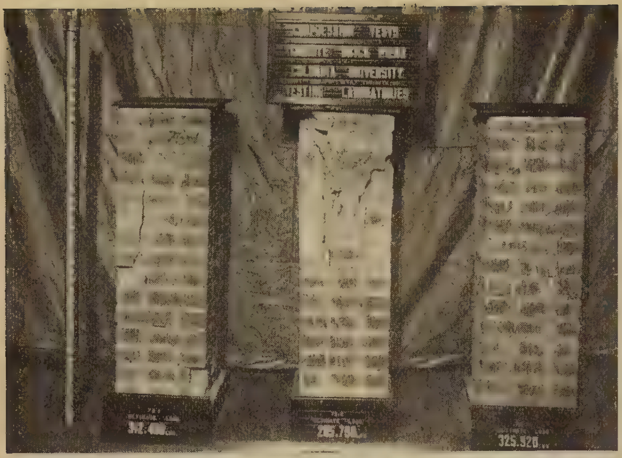
Using the following nomenclature, the relation between the properties of the brick and the properties of the corresponding masonry is indicated by the following, for brick laid in 1:3 portland cement mortar:

X =Compressive strength of brick.
Y =Compressive strength of pier.
R =Transverse strength of brick (modulus of rupture).

Table 1

Bricks and Piers Marked	—Summary of Results— Tests of Brick (Aver. of 5) Comp. lbs./sq.in. X	Trans. lbs./sq.in. R	Absorp. %	—Concrete Brick and Piers— Tests of Piers (Aver. of 3), Comp. Str'ngth lbs. per sq. in. Y	Tests of Mortar Used in Building Piers, 1 part Cement:3 parts Sand (Aver. of 3-2 in. Cubes)	—Ratio of Comp. Strength of Pier— to Srength of Compressive Strength of Brick K	Transverse Strength of Brick K1	To Strength of Mortar
A-18	1,853	437	10.8	1,348	2,099	0.728	3.08	0.64
B-20	3,446	638	9.3	1,840	2,442	0.534	2.98	0.75
77	4,706	823	8.8	2,032	1,439	0.432	2.46	1.41
78	4,086	751	9.6	2,165	1,663	0.530	2.88	1.30
79	2,544	538	10.9	1,654	1,601	0.649	3.08	1.03
80	3,598	709	8.7	1,991	1,934	0.555	2.82	1.03
81	2,332	530	10.8	1,613	1,784	0.694	3.05	.91
82	1,828	377	11.8	1,135	1,898	0.623	3.02	.60
83	2,738	553	9.2	1,568	1,694	0.573	2.83	.92
84	2,056	471	10.3	1,262	1,654	0.616	2.68	.76
85	1,501	325	12.3	1,064	1,619	0.708	3.27	.66
86	1,555	230	11.2	770	1,605	0.495	3.34	.48
88	1,150	274	12.3	847	2,396	0.735	3.10	.35
Average—concrete brick	2,569	512	10.5	1,484	1,675	0.582	2.97	.87
Mixture of concrete brick Nos. 77 to 88	(2,606)*	(517)*	....	1,184	1,682	0.455	2.30	.71
				—Clay Brick Masonry—				
Brand "A" clay common brick	2,819	746	16.0	695	2,119	0.247	0.93	.33
Brand "B" clay common brick	3,578	503	18.4	966	1,879	0.270	1.92	.51
Brand "C" clay common brick	5,592	707	16.5	1,305	1,810	0.234	1.85	.72
Average clay brick	3,996	652	....	989	1,936	0.251	1.56	.52
Mixture of Brands "B" and "C"	(4,585)*	(605)*	....	1,165	1,369	0.254	1.92	.85

*Average of tests of types of individual brick used in composite piers.



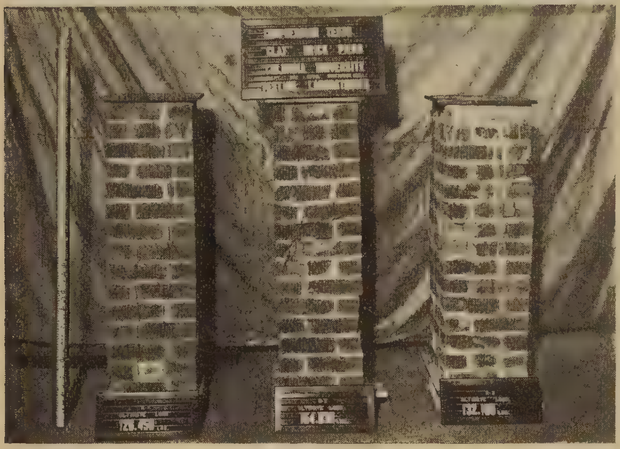


Fig. 5—Compression Tests of Crozite Brick Piers
Fig. 6—Compression Tests of Clay Brick Piers

K =Ratio of compressive strength of piers to compressive strength of individual brick.

KI=Ratio of compressive strength of piers to transverse strength of individual brick.

For concrete brick, irrespective of the concrete mixture used in their manufacture:

(A) Y=4.2 x ¾ (approx.).
(B) K increases from .42 to .71 as
  X decreases from 5,000 lbs. per sq. in. to 1,500 lbs. per sq. in.
(C) K1 increases from 2.65 to 3.30 as
  R decreases from 800 lbs. per sq. in. to 250 lbs. per sq. in.

For clay common brick (Hudson river), the following corresponding relations appear to hold:

(A) Y = .25X (approximately constant)
(B) K = .25 (average)
(C) K1=1.56 (average)

While the basis for the relations between the properties of clay brick and clay brick masonry is far from comprehensive in this series of tests, consideration should be given to the closeness with which the values of K and K1 check the average results given in the sum-

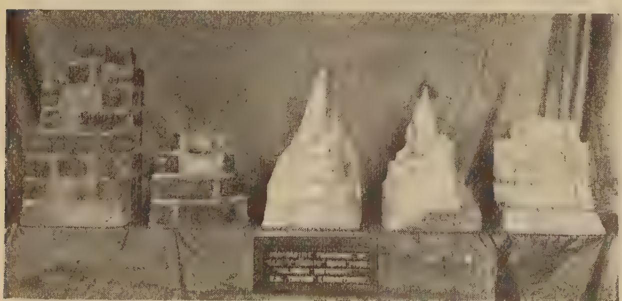
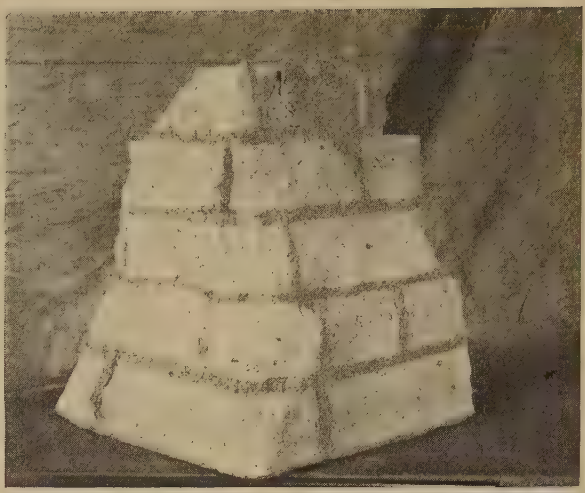
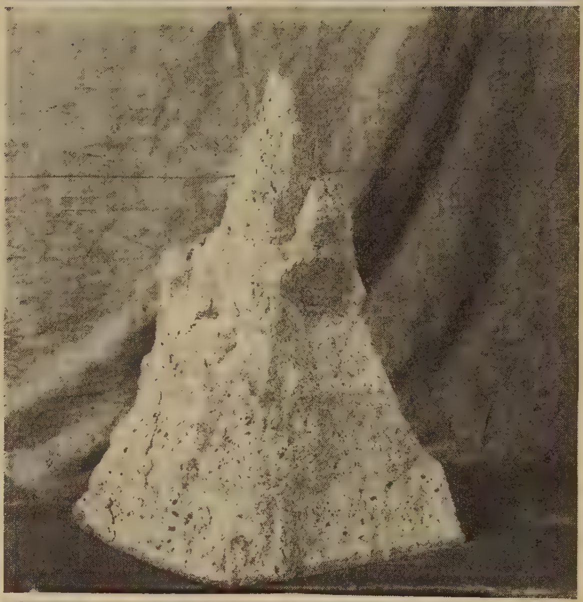


Fig. 10—Comparative Fractures of Clay and Crozite Brick Piers—Columbia University C. E. Testing Laboratories





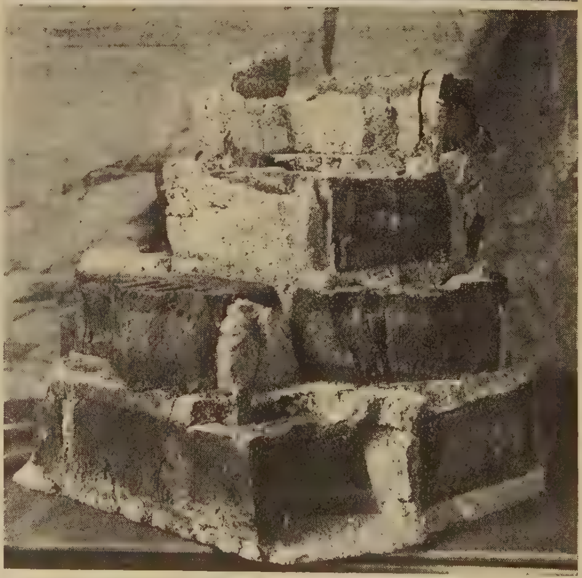


Fig. 7—Crozite Brick Pier No. 83-1, Showing Conical Fracture

Fig. 8—Crozite Brick Pier No. 78-3, Showing Conical Fracture

Fig. 9—Clay Brick Pier No. D-2, Showing Typical Fracture

mary on page 39 of Technical Paper No. 111 of the Bureau of Standards on the "Compressive Strength of Large Brick Piers."

CONCLUSION

Table 2 gives the strength of masonry that corresponds to brick of various compressive strength.

TABLE 2

Compressive Strength of Brick—Lbs. per Sq. In.	Strength of Masonry Laid in Mortar 1 Cement : 3 Sand Concrete Brick: Y=4.2x¾	Clay Brick: Y=0.25X
1,500	1,000	375
2,000	1,250	500
2,500	1,500	625
3,000	1,700	750
3,500	1,920	875
4,000	2,075	1,000
4,500	2,160	1,125
5,000		1,250

Table 3 gives the strength of masonry based on the relation to the transverse strength (modulus of rupture) of various brick:

TABLE 3

	Concrete Brick		Clay Common
Transverse Strength of Brick	Value of K1	Comp. Strength of Masonry, lbs. per Sq. In.	Average Value of K1 = 1.56 Comp. Strength of Masonry, lbs. per Sq. In.
250	3.30	825	390
300	3.25	975	478
400	3.15	1,260	636
500	3.00	1,500	795
600	2.90	1,740	954
700	2.80	1,960	1,111
800	2.65	2,120	1,270

It is apparent that specification for concrete brick for building purposes should recognize the fact that the ratio (K) of the compressive strength of the masonry to the compressive strength of the individual brick is considerably higher and varies with the compressive strength of brick in the case of wet mixed concrete brick, while this ratio is fairly constant for clay brick.

The foregoing simply means that to produce masonry of the same strength, the strength requirements of the individual brick would be considerably lower in the case of wet mixed concrete brick than for clay brick.

Acknowledgment is made to A. H. Beyer, Director of Testing, and W. J. Krefeld, Engineer of Tests of the Civil Engineering Department, Columbia University, for making the tests, and to Rudolph P. Miller, Albert E. Kleinert, John W. Moore, P. J. Reville, and William J. McDermott, superintendents of the Bureaus of Buildings of the various boroughs of New York City, and their representatives for their cooperation.

A good deal of the odium in which "systems" are sometimes held is a result of incompetency in their application. If you have a system for filing data in your office be sure that it is correctly administered. Sullivan W. Jones, a New York architect, tells of the experience of a brother architect who found data on "fly screens" filed under the classification "Aviation."—*Retail Lumber Dealer.*

Bates Road Test Results

The second, third and fourth of the traffic runs to be conducted on the Bates Experimental Road have been completed.[1]

The start of the second run was marked by changing the path of the trucks from the extreme edge of the pavement to a path 2 ft. 6 in. from the edge. The results of this change seems to prove that it is entirely possible that the material necessary to construct a narrow, rigid slab of sufficient strength to carry given wheel loads, if used to construct a thinner slab of greater width would result in a pavement of equal or greater durability. Such a result would be due to the fact that wide roadways would in all probability lessen the frequency of the application of maximum loads to the weak points, the corners. Reasoning along this line, it seems quite possible that added load carrying capacity can be secured more cheaply by adding to the width of the pavement than in any other way.

After a total number of 1,167 applications of this load it was noticed that exceptionally strong support was given the corners of the sections by the adjoining slabs. In other words, the pavement, due to prevailing warm weather, had expanded to such an extent that the loads were distributed across the joints which contained no dowels in the same manner as over joints containing dowels. This condition eliminated to a great extent the free corners or weakest points in the slabs, and resulted in a greater strength of section than is normally the case during the late fall, winter and spring months.

To prevent this condition, one transverse cut about 1 in. wide was made through each section of pavement of rigid type and the cut thus formed was filled with asphalt. The traffic was then started and 1,000 additional applications of the load made.

The opening of the cracks and joints, due to cold weather, makes a marked difference in the carrying capacity of a given pavement, as is shown from the results obtained from this test. Only two corner breaks occurred during the 1,167 applications of the 3,500-lb. load before the joints were cut, and seven corner breaks occurred during the following 1,000 applications of the same load applied after the joints were opened.

Preliminary investigations on the Bates Road showed conclusively that during the night the edges of rigid type pavements curl up, and while in this position receive very little or no support from the subgrade. Pavements in the localities where night traffic is imposed upon them, especially in the vicinities of large cities, must necessarily withstand this extreme condition of strain, and it was with this in mind and to gain an insight to the actions of various types of pavements subjected to this condition, that the night runs were made. As the maximum curling of pavement has been indicated to take place between the hours of 9:00 p. m. and 6:00 a. m., the night traffic was applied between these hours.

It was noted that more failures occurred at night under 1,000 applications of load than occurred during the day runs with 2,000 applications. This in itself is indicative to a conclusive degree that the curling action of the pavements makes these slabs more susceptible to failure at night than at any other time.

Stucco Investigation

The Bureau of Standards, in cooperation with interested manufacturers, is to carry out an investigation of stucco bases made of woven wire cloth and expanded metal lath. It is expected that three types of base now in general use will be applied over sheathed construction, and the performance of the various panels will be noted and analyzed.

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[1] See CONCRETE, May, 1922, p. 225.

How to Make Forms for Concrete Buildings —*Flat Slabs*—*Continued*

The Second Part of the Fifth Article of a Series for the Builder Who Wants to Know the Subject From the Beginning

(Continued from June Issue)

By William F. Lockhardt
Lockhardt-Byrne Co., Inc.
New York City

Articles on forms for Footings, Columns, Walls, and Beams and Girders and the first part of the article on Forms for Flat Slabs, have been published in five previous issues, and the series will be continued. The present article on Forms for Flat Slabs is in two parts, of which the second part appears this month. Mr. Lockhardt's descriptions of form work are based on the actual practice of some of the most successful concrete building contractors in the United States. Various methods have been tried, and these methods have survived. If any reader is in doubt about some step in form building, when he has read Mr. Lockhardt's article on any one of the special subjects in the series, he will be conferring a favor on the editors and on many readers if he will ask to have the point more fully explained. A reader who has used form building methods different from the methods here described, and which he believes better for any reason whatever, will be adding something to the consideration of a very important subject if he will describe those methods for this magazine.—The Editor.

The actual construction details of the different systems of flat slab forms so far described are all very much alike, and the one general method of working out sizes and clearances will apply to all the systems.

As in dealing with beam and girder forms, a lumber list should be made up to show the sizes, quantities and the parts for which the lumber is intended. A sketch should accompany the list to enable the carpenter foreman to tell for just what part of the work the different sizes and lengths of the material are ordered. The sketch can of course be of the simplest and most elementary form, just enough to give an idea of the type of construction that was in the mind of the man who took off the lumber quantities.

A sketch similar in arrangement to Fig. 12 will serve very well, if it is properly dimensioned. The floor-to-floor story height should be given, and then, reading down from the finished floor to be poured, should be noted the thickness of the slab, thickness of floor panel, depth of spreaders and ledgers, length of shores and the clearance allowed under the shores for the necessary wedging adjustment to compensate for the irregularities that will creep into the most carefully finished floor.

The actual sizes of the floor panels, after the general arrangement has been worked out, are dependent upon the size of the depressed section. As the drop panels are always placed before the slab forms, they will be considered first. Fig. 6 shows two different methods of building these panels. The type at the left of the illustration is the more generally used in one form or another, although some carpenter foremen who have used both types claim that the other type is much better. It is a small matter, depending principally upon the individual foreman's way of working. The first type shown is made up of a single thickness of 7/8 roofers stiffened and held in place by battens or cleats on the back of the panel. The battens as shown in the drawing are 1 x 6's, but the common practice is to use 2 x 4's on edge to make the panel rigid. The other panel is made up of two layers or laminations of roofers laid in opposite directions. This panel has all the advantages of any laminated construction as far as strength is concerned, and will stand more grief than the first type of panel. For depressed heads of large area these panels are usually quite flexible, and accordingly hard to handle, but so, too, is the first type unless stiffened up with 2 x 4 or 3 x 4 battens.

When a sheet metal column form is to be used on a job before making up the depressed panels, at least as far as cutting the opening for the column capital is concerned, obtain from the column mold erector the size and details of the opening in the panel he will require to fit his construction. The column mold idea is built up on a system of plates, clamps and irons which cannot be changed, so that it will be necessary to change the forms to suit the metal work, if the forms are made so that they cannot be used "as is."

Typical details used in two different column mold systems are shown in Fig. 7 for the column capital, where it is connected with the drop panel. In the system marked "a" the opening in the drop panel is practically the same diameter as the column capital, which has a lip turned over that rests upon the surface of the panel. This edge of metal leaves a depressed ring in the concrete around the capital, which nearly always requires some pointing to patch up satisfactorily. The arrangement is also open to the objection that the sheet metal capital cannot be taken down until the drop panel has been stripped. The other method, marked "b," requires a slightly larger opening in the drop panel, this being marked "clearance" in the drawing. Nailing blocks and wedges are fastened around the edge of the opening, and a heavy angle-iron ring placed on the blocks to support the light metal of the mold between the blocks. This ring is gauged to come about 1/8 below the surface of the drop panel, so that when the capital form is

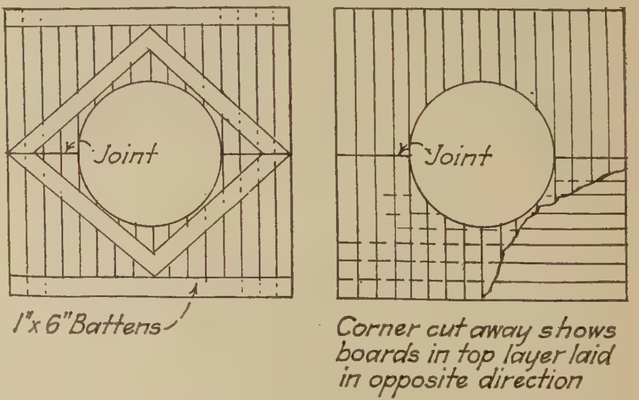

Joint
Joint
1"x 6" Battens
Corner cut away shows boards in top layer laid in opposite direction

Fig. 6—Two Methods of Making Up the Drop Panel at the Column Capital

placed the turn-over lip will just come flush with the surface of the drop panel. With this type of construction it is not necessary to wait for the drop panel to be stripped to get the metal mold. By removing the wedges the ring can be dropped, thus freeing the sheet metal form for immediate use elsewhere.

Figs. 8 and 9 are vertical sections through the loose-spreader system of forms shown last month in Fig. 1, which is probably the most commonly used type. Fig. 9 is a section through the upper part of the form system, extending from column to column, taken across the 4 x 6's, and parallel to the spreaders. Fig. 9 is a similar section taken in the other direction, to show the spreaders in section and the 4 x 6's in elevation. These sections show the floor panels made up on 1 x 6 battens or cleats, laid on the loose 3 x 4 spreaders, which are in turn supported by the 4 x 6 ledgers, which are cleated to the top of the shores. A bevel piece is fitted around the edge of the drop panel, which helps to support the extreme end of the floor panel.

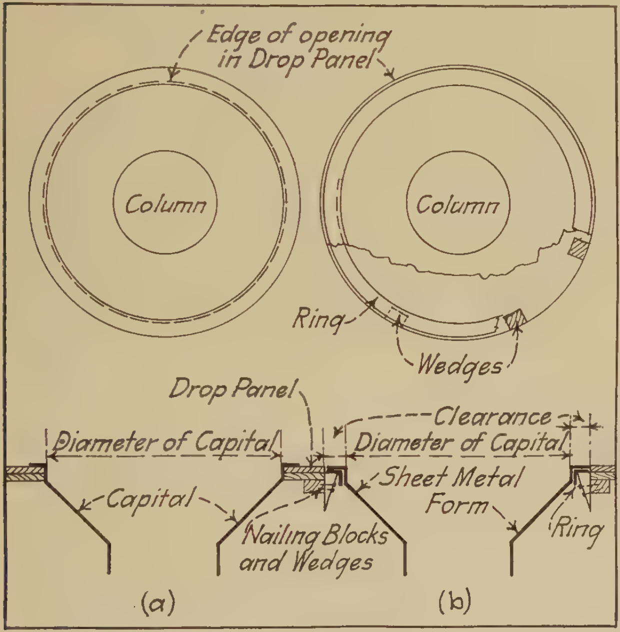


Fig. 7—Two Methods Employed Where the Sheet Metal Column Capital Joins the Drop Panel

It will readily be seen that where the depressed section around the column capital is sufficiently shallow, it is entirely possible to omit the special bent construction at the columns, and carry the drop panel on the 4 x 6's.

The forms shown last month in Fig. 3 are illustrated in more detail by the sections given in Figs. 11 and 12. Fig. 10 is a full story height section through the forms at the column, taken as indicated at *"A—A"* in Fig. 3. The section shows the column bent with the 2 x 6 "spacer" extending to the next bent on either side, and bolted to the bent at the right elevation to carry the 4 x 6's. If the column spacing is regular throughout the building, no special marking will be necessary for the spacers, but if there is great variation in the different bays, more than can be taken care of by adjusting the location of the bolt holes, the spacers will have to be plainly marked to avoid confusion. It is necessary that the spacers work out exactly right for each bay, as the guide cleats shown on them must carry the 4 x 6 just where it will catch the ends of the spreaders under the panels.

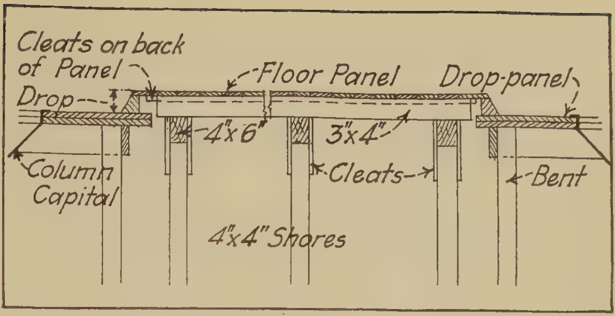


Fig. 8—Section Through Form System Shown in Fig. 1, Taken Parallel to the Spreaders

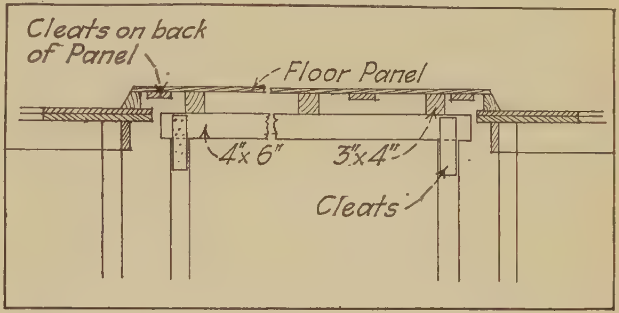


Fig. 9—Section Through Form System Shown in Fig. 1, Taken Across the Spreaders

If the desired system may be modified by running the panels at right angles to those shown in the plan, Fig. 3. The spreaders will then parallel the long axis of the panels, and the boards will run across the panel, similar to the panel shown in Fig. 2. This method has the very decided advantage that the same degree of accuracy in placing the 4 x 6's is not required, except at the ends of the panels.

The section shown in Fig. 11 is taken looking the same as "B—B" marked on Fig. 3, but is taken below it, at a point midway between the columns. A section at "B—B" would be practically the same as Fig. 10, with the exception that the bevel pieces forming the sides of the depressed section would here be made fast to the panel and as the spreaders are also made fast to the panel, to serve as cleats or battens as well, the 1 x 6 cleats shown would be unnecessary.

Fig. 11 shows clearly the 2 x 6 spacer, this time in section, the 4 x 6 which it spaces, and the posts under the 4 x 6. It should be noted that the 2 x 6 does not carry anything but the temporary weight of the 4 x 6's. Before the concrete is poured, or before even the floor panels are placed, the 4 x 4 shores should be placed in position and made fast.

In Fig. 3 the drop panels are shown as extending over at two sides as far as the 4 x 6's. This is not necessary, of course, and in some cases, where the depressed section is quite deep, it is impossible. This may make it necessary to use specially built small filler panels on these two sides of the drop panel. These panels are shown in section in Fig. 10 and are marked "Filler." They are usually made up with the usual bevel piece in front, and back of this 2 x 4's or 2 x 6's, as the occasion requires, to carry the ⅞ sheathing. The bevel pieces to form the other two sides of the depressed section are usually attached to the floor panel when the floor panel is made up on the spreaders.

It should be noted that variations in the thickness of the 4 x 6's are a minor matter, as it is possible to keep the top edge of the 4 x 6 at the required elevation by an adjustment of the wedges under the shoring. The spreaders, however, cannot be adjusted, so that it is cus-

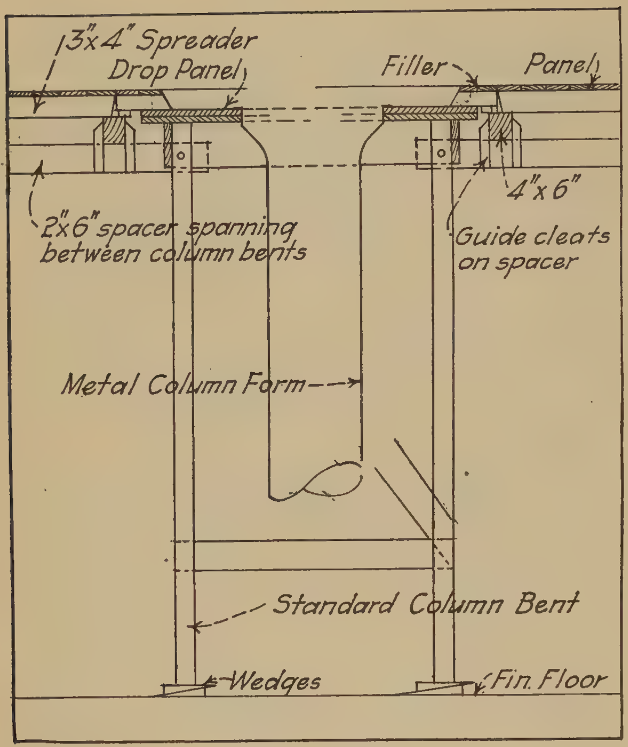


FIG. 10—SECTION AT "A—A" IN FIG. 3

tomary to use dressed lumber sized to an even dimension, such as $3\frac{3}{4}$ in., for this purpose.

A detail of the construction used at the permanent shores shown in Fig. 5 is given in Fig. 12. Reference to Fig. 5 will show that the permanent shores are all so placed that they come immediately adjacent to a 4 x 6 ledger. In Fig. 13 the shore is shown to carry a "bracket block" which acts as a shelf on which, after the wedges have been placed, the 4 x 6 may be carried, thus doing away with a 4 x 4 shore at this point. In stripping, the wedges are taken out first and the 4 x 6's then removed. After the 4 x 6 is down the panels may be lowered as usual, the shore with its cap-piece remaining in place undisturbed, however, until sufficient time has elapsed according to the schedule for stripping.

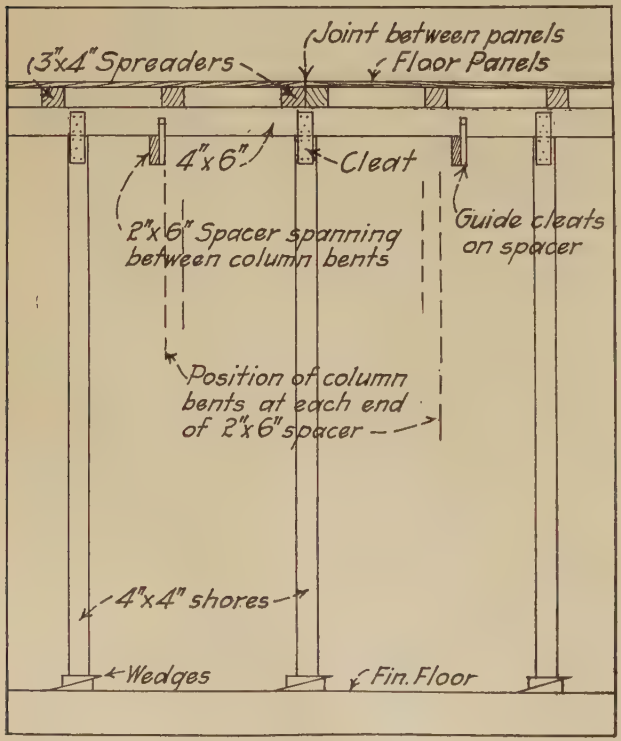


FIG. 11—SECTION OF THE FORMS SHOWN IN FIG. 3 TAKEN PARALLEL TO "B—B," BUT BETWEEN COLUMNS

The use of loose plank, as shown in Fig. 4, cannot well be extended to columns, curtain walls, parapets, etc. For these and other special purposes, such as stairs, the amount of cutting and fitting required will often render the plank practically valueless for use as underflooring, for which it was bought primarily. For these special uses it is advisable to buy the regular $\frac{7}{8}$-in. sheathing and confine the use of the loose plank to the floor forms alone. "T" shores can be made up by spiking plank together, but it is frequently just as cheap to buy 4 x 4's, which can afterward be used as standards for walls, etc.

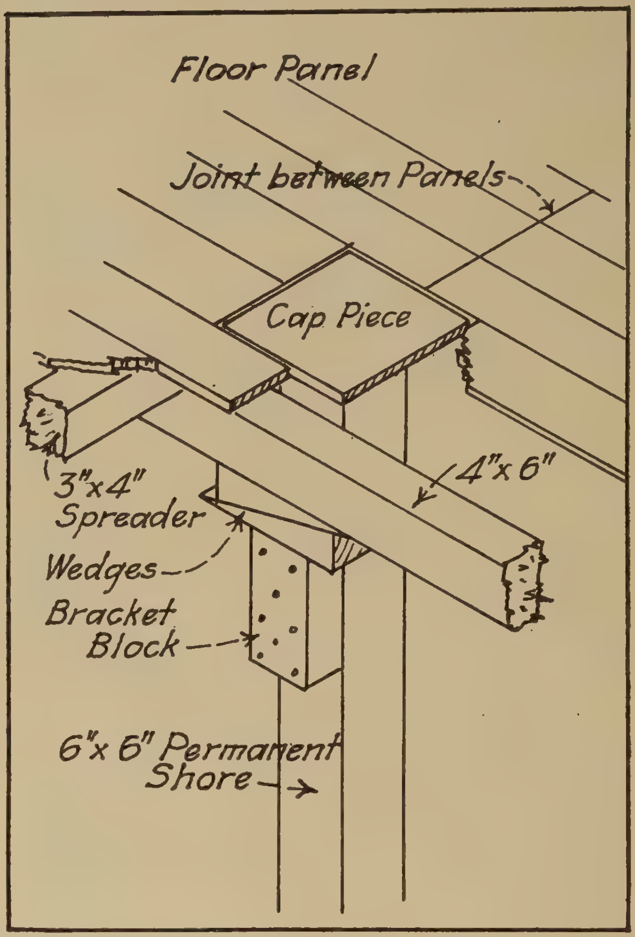


FIG. 12—DETAIL AT 6x6 "PERMANENT SHORE" USED WITH FORMS SHOWN IN FIG. 5

Arrangements have been made for a cooperative examination of sewer pipes used in Los Angeles, the work to be conducted by the Bureau of Standards, interested manufacturers, trade associations, and the City Engineer's office of that city. The object of the work is to discover whether present standard specifications insure a sufficiently high grade and durable pipe to withstand the rather severe alkaline conditions existing in that territory.

A conference was held April 11 at Los Angeles and was attended by twenty representatives of the city, clay and cement interests. An investigational program was discussed and approved at the meeting. Excavations and installations of test sections are now being carried out.

Central Mixing Plant for Colorado Springs Paving Job (From Extreme Left to Right of Box Car—The Remainder of Trestle Was Used by Coal Company)

Colorado Springs and Interurban Railway Co. Paving Job

In January, 1921, the City of Colorado Springs, Colo., received bids on one of the largest paving districts ever formed by a city in the west. These bids were finally all rejected. There then developed the possibility of the Colorado Springs & Interurban Railway Co., the local street car company, taking the paving contract, and they were approached by the business men of the city and were finally prevailed upon to bid upon this work at the next letting.

Their reasons for this were two-fold. First, that the company was the largest single taxpayer in Colorado Springs, and accordingly interested in as economical a procedure as possible, and secondly, it was believed the company might effect a considerable saving to the City of Colorado Springs if it were to attempt to do the work at cost. A plan was finally adopted by which the company filed a bid at the next letting, attaching thereto a supplemental agreement whereby all the necessary equipment purchased to do the work, together with all profits accruing from the performance of the contract, were, upon completion of the contract, to revert to and become the property of the City of Colorado Springs.

The company's bid was $5,000 less than the previous low bid, and the contract was awarded on June 24, 1921, and involved the following approximate quantities:

Two hundred fifty-three thousand square yards of asphaltic wearing surface, Topeka mixture, laid on a five-inch concrete base. About 90,000 cu. yds. of excavation, about 100,000 linear feet of curb and gutter, about 10,000 linear feet of 10-in. to 36-in. pipe, together with numerous other incidental work. The total value of the contract when completed will be a little over $1,000,000.

At the time the Colorado Springs & Interurban Railway Co. was awarded the contract it had no paving organization or equipment of any kind. The plan of operation for the concrete base was the central mixing plant, which was located in connection with an old railroad trestle. The space occupied by the central mixing plant on this railroad trestle, which is 23 ft. above the ground, is 116 ft. in length. Bunkers were constructed underneath this trestle, having a capacity of 650 cu. yds., and were divided into compartments for sand and rock. The material from these bunkers, which extended to within about 3 ft. of the ground, was taken out from the bottom of the bunkers on conveyor belts, discharged into a double elevator, one for rock and one for sand. This elevated the material into a small auxiliary bunker, holding approximately 25 cu. yds. of sand and rock. From this bunker the material fed directly into a batch hopper, which in turn discharged into a T. L. Smith 1-yd. stationary mixer. The mixer was sufficiently elevated, as shown in the accompanying illustrations, to permit discharge directly into auto trucks.

Cement was received on the same trestle in carload lots. While the plant was in operation the cement was fed to the mixer direct from the car by a gravity chute to the batch hopper. When the plant was not in operation the car was unloaded from the same location down another gravity chute into a storage warehouse immediately adjoining the mixing plant, which had a capacity of about ten carloads. Any time the plant was in operation without cement cars on the trestle, cement was delivered from the storage warehouse by an inclined conveyor belt feeding directly into the batch hopper.

The labor involved for handling the cement from either the car or warehouse was the same. The entire mixing plant was operated by a foreman, one man on the trestle taking care of material, one man charging batch hopper from the auxiliary bunker, one man putting cement into the batch hopper from either car or warehouse, one man operating the concrete mixer, one man caring for the feed from the main storage bunker on to the conveyor, one man handling empty sacks, three men handling cement, and two extra general laborers. The total labor costs for the 1921 operations were 3½c per sq. yd., and to this is an additional cost of 2½c for power, repair parts, maintenance, interest and depreciation.

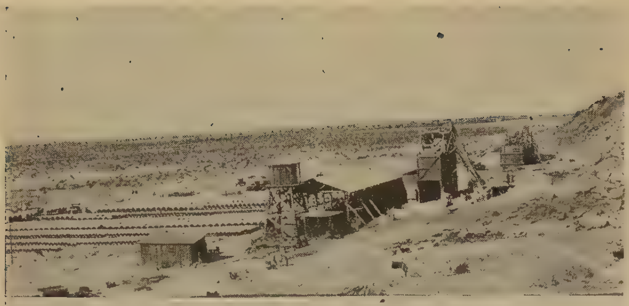
The plant was actually operated 52 days, from September 2 to November 6, and laid a little over 120,000 sq. yds., or an average of 2,300 sq. yds. per day. The working days averaged about nine hours. The biggest day's run was 419 cu. yds. and average mixing time was about one minute and twenty seconds.

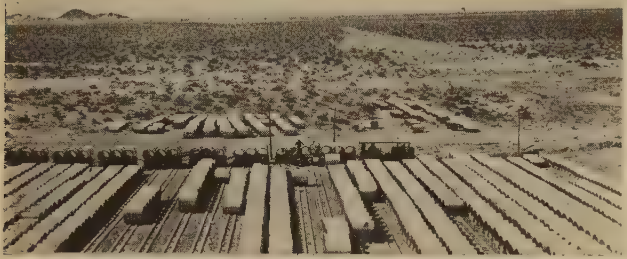
The mixed concrete was hauled to the streets by auto trucks with end dumps, the average haul being approximately two miles. The largest number of trucks used at any one time was 10—14 3½-ton trucks and four 5-ton trucks, hauling 2 cu. yds. and 3 cu. yards of concrete, respectively. There was no particular difficulty experienced in dumping the concrete from the auto trucks on the streets, nor in spreading it.

The total costs of laying 5-in. concrete base for the entire 1921 season was 4½c per sq. yd. The mixture was 1:3:5 and 1 cu. yd. of concrete was mixed at a batch. The Colorado Springs & Interurban Railway Co. produced its own rock aggregate at Cripple Creek, using one of the old mine dumps as the company's other source of supply. They used two No. 5 Allis-Chalmers gyratory crushers and a complete screening plant, all of which had a capacity of about 600 cu. yds. of screened material in eight hours. All of the rock was shipped to the central mixing plant in 100,000 capacity steel bottom dump gondola cars. The sand was obtained locally about a mile from the mixing plant.

The 1921 season's run was accomplished with virtually no loss of time due to breakdowns in the performance of the mixer or auto trucks, and the general scheme of operation throughout was highly satisfactory.

For this information Concrete is indebted to R. H. Kimball, superintendent, paving department, Colorado Springs & Interurban Railway Co. Mr. Kimball was retained by the company to take charge of the entire operation, including purchase of equipment, building up organization and designing plants and plan of construction.





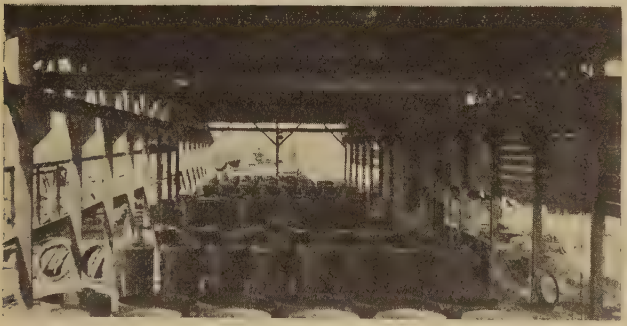


FIG. 1—CONCRETE PIPE PLANT, U. S. RECLAMATION SERVICE, YUMA, ARIZ.

FIG. 2—STORAGE YARD OF CONCRETE PIPE PLANT—VIEW FROM MATERIAL BIN SHOWN IN FIG. 1

FIG. 3—INTERIOR OF PIPE PLANT

Making Pipe to Irrigate Yuma Land

BY M. W. LOVING
CHICAGO

The first unit of 6,000 acres on the Yuma Mesa, comprising a total area of 40,000 acres, will be irrigated by means of a concrete pipe system in which over 105,600 ft. of concrete pipe, 15 in. to 45 in. size, will be used.

This system is designed to deliver water to a given point on each 40-acre tract, and before the orchards are planted each unit will require approximately 5,000 ft. of 15-in. pipe, or a total of 750,000 ft., in addition to the 105,600 ft. for the main system. The remaining 36,000 acres will undoubtedly be developed in the near future, as the land is particularly adapted for growing citrus fruits, being free from frost hazards and the fruit is of excellent quality and ripens six weeks ahead of that grown in other sections of the Pacific Coast region, according to the local growers.

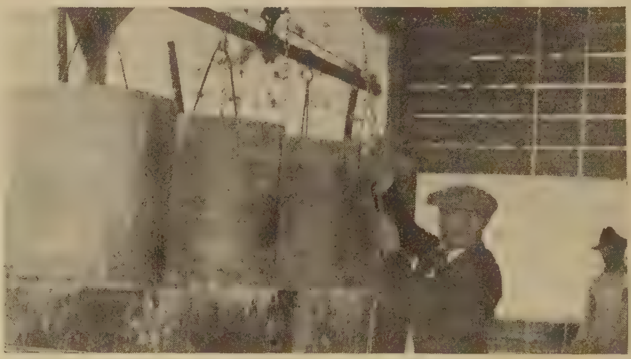
Concrete pipe is being manufactured in an efficiently designed plant by the Reclamation Service, using the patents of the Lock Joint Pipe Co. Views of the plant are shown in Figs. 1 to 4, inclusive. Credit for the design of the plant is due, according to Porter J. Preston, project manager, to S. A. McWilliams, construction engineer. Very good methods are used from the time the raw materials are taken from the bank until the pipe is actually installed a distance of 9 to 10 miles from the plant.

Raw materials are quarried just behind the material bins, shown in Fig. 1, elevated to the screening tower by means of bucket conveyors, pass through a rotary screen, which separates them in two grades—dust to ¼ in. and ¼ in. to 1 in. From gravity bins the materials are proportioned and discharged into the mixer. The concrete is mixed in a batch mixer to a quaky consistency, from which it is distributed to the molds by means of patented conical buckets, operating on three gantry cranes.

The plant shed is 170 ft. by 30 ft., and provided with a concrete floor. The molds were purchased in the different sizes, according to the number of each size of pipe required in the first eight miles, which is to be fabricated in 100 days. For each set of molds, consisting of an outer and inner casing, three sets of pallets or lower rings were secured. In this way the pipe are not removed from the lower rings until the fourth day—thus allowing ample time for curing in the shed by means of wet burlap.

By using this system, the plant is turning out each day 16 ft. of 15-in. pipe, 160 ft. of 18-in. pipe, 28 ft. of 21-in., 4 ft. of 24-in., 64 ft. of 27-in., 40 ft. of 30-in., 48 ft. of 33-in., 56 ft. of 36-in., 4 ft. of 39 in., 4 ft. of 45-in., or a total of 424 ft. Actual pouring of concrete consumes approximately three hours, and the rest of the time is devoted to setting up forms, placing reinforcement, and removing pipe to storage yard, where it is sprinkled at frequent intervals for several days.

Special attention is called to the arrangement of the interior of the plant, as shown in Fig. 3. Chain hoists operate on three gantry cranes, thus facilitating easy handling of the molds, as well as the pouring of concrete.



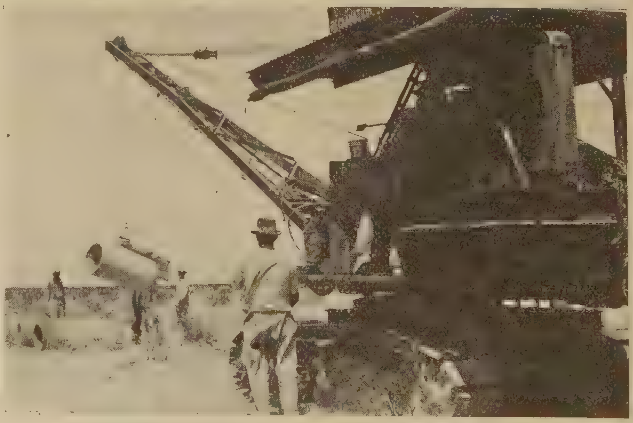


FIG. 4—REMOVING INNER FORMS FROM 24-IN. REINFORCED CONCRETE PIPE WITH CHAIN HOIST OPERATING ON GANTRY CRANE

FIG. 5—LAYING 18-IN. CONCRETE PIPE—PIPE LIFTED BY P. & H. DRAGLINE EXCAVATOR, USING A "CLOTHES-PIN" HOOK TO FACILITATE EASY HANDLING

In Fig. 4 is shown the method of withdrawing three inner casings at one operation.

The pipe is rolled by hand to the storage yard in rows according to sizes, over boards as shown in Fig. 2, which was taken from the screening tower. The pipe are then loaded on to trailers operating on a depressed roadway. Each trailer will carry six 4-ft. joints of 36-in. pipe, and a train of eight trailers is drawn nine to ten miles over the sandy trails by one caterpillar tractor, where the pipe is installed by means of a half-yard dragline excavator, as shown in Fig. 5.

Over 1,300 ft. of any size of pipe can be laid and the joints sealed, each day. The excavating and backfilling is done with the same machine. Particular attention is directed to the clasp or "clothes pin" used for picking up pipe. This facilitates efficient handling with minimum breakage loss.

Garages Built of Precast Units

A concrete garage that can be delivered to a yard on an ordinary truck and be erected and made ready for use in a day, has been developed by W. C. Broughten, a Kansas City, Mo., products manufacturer.

The entire garage, which is called an "Auto Safe," with the exception of a concrete floor, which is cast on the ground, is constructed of precast units, including slabs, pilasters, sills, plates, collar-beams, rafters and other necessary members. Lightweight aggregate, known as Haydite, is used in these units, making them light so that two men can easily handle them.

Garage Assembled from Precast Units

The floor is placed first. After this has hardened, a pilaster 8 ft. high is erected at one corner and a section of sill placed. Then one of the slabs, 33 in. by 8 ft. by 1 in., is placed. The pilasters and sills are slotted so that the edges of the slabs will fit snugly into them. Next, an intermediate pilaster, slotted on two sides, is erected; another section of sill is laid and the second slab placed. This operation is repeated until the entire structure is completed.

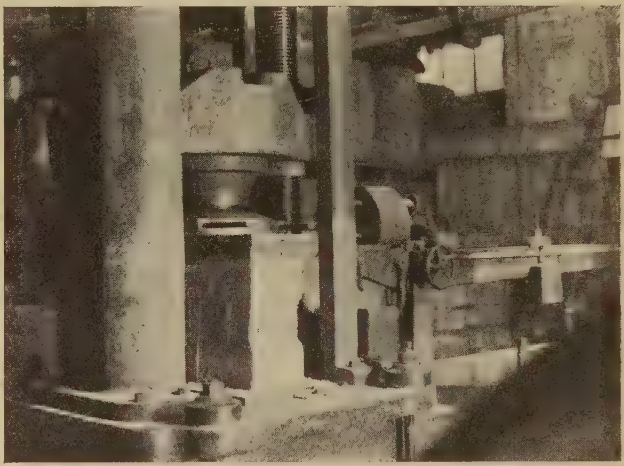
Precast plates similar to the sills are then fitted to the top of the wall. To prevent spreading, opposite sides of the wall are tied together with precast collar beams. These beams are bolted at the ends to the pilasters by means of bolts cast in the pilasters. The roof, which is of slab construction, is supported by precast rafters three feet apart. The lower ends of the rafters rest on the pilasters and are bolted to the collar beams.

The doors consist of concrete slabs cast in special steel frames, provided with hinges so that the various sections will swing together. Hinges are attached to the corner piers by bolts cast in them.

Window sash are also of concrete and are glazed with wire-glass panes. Special, short length wall slabs are used above and below the windows. These are slotted on the ends next to the window, which insures a tight fit. The sides of the sash fit into slots in the pilasters.

No mortar is used anywhere in the erection of the garage. It can be dismantled, moved and erected readily.

This garage is now being marketed by the Auto Safe Co., which feels that the idea can be applied to various other uses, such as summer homes, oil filling stations and various farm structures.—*Concrete Builder,* courtesy Portland Cement Assn.


Testing Concrete Unit for Compressive Strength

How Well Are Concrete Block Made in Practice?

By A. J. R. Curtis
Chicago

There has been a great deal of speculation during the last few months as to the quality of concrete block made throughout the country. "Are our American Concrete Institute Specifications too high or too low, judged by economical manufacturing standards?" and "Do block manufacturers generally approach these recognized requirements?" are questions which have been asked frequently.

In reply, let us present some data on block tests which the writer has had an opportunity to examine during the last few months. All of the tests referred to were conducted on an Olson compression machine, in accordance with American Concrete Institute standards for testing concrete block.

Out of a total of 112 block tests examined, it was found that the poorest specimen tested 510 lbs. per sq. in. on the gross cross section. Six specimens tested below 600 lbs. on the gross cross section, 11 specimens between 600 and 700 lbs., 19 specimens between 700 and 800 lbs., 8 specimens between 800 and 900 lbs., 20 specimens between 900 and 1,000 lbs., 10 specimens between 1,000 and 1,100 lbs., 13 specimens between 1,100 and 1,200 lbs., 2 specimens 1,200 and 1,300 lbs., 9 specimens 1,300 to 1,400 lbs., 13 specimens 1,400 to 1,500 lbs., and one specimen which reached 1,550 lbs.

The compression tests reported above ranged from 920 lbs. to the square inch to 3,400 lbs. to the square inch on the net cross section. Only three of the specimens tested under 1,000 lbs. to the square inch on the net section, usually considered the low limit for acceptable concrete in block. The average of these tests, most of which may be considered random tests, was 980 lbs. on the gross section.

Although 64 specimens fell below the present American Concrete Institute requirement of 1,000 lbs. per sq. in. on the gross section, and only 48 specimens exceeded that figure, only 25 specimens dropped below 750 lbs. per sq. in. on the gross cross sectional area (which is now being considered as a possible requirement in new American Concrete Institute specifications).

The absorption tests made on these same block parallel the compression tests quite consistently. These absorption tests were made by drying and weighing the block, then immersing in pure water for 48 hours and again weighing. Present specifications limit the amount of water absorbed to 10% of the original weight of the block. Five specimens tested showed an absorption of only 3.8%. The highest percentage recorded was 13.8%. The block which had the highest compression test (1,550 lbs. per sq. in. on the gross area) was one of the five which had an absorption of 3.8%. The block with the highest percentage in absorption tested only 640 lbs. per sq. in. gross, in compression. The lowest testing compression specimen, 510 lbs., had an absorption of 12.7%. Density and strength of block are, under ordinary conditions, approximately proportional.

There is little doubt that with the rapid increase in block testing these averages are on the rise. So far as strength and resistance to weather are concerned, these figures prove again that present block are structurally acceptable and abundantly able to sustain with a wide margin of safety such loads as are generally placed upon them.

FROM THE STANDPOINT OF COMPETITION

The following table gives a comprehensive idea of the requirements imposed on a typical competing material, hollow clay tile.

Should code requirements finally reach a staple condition somewhere in the neighborhood of 70 lbs. to 750 lbs. on the gross cross sectional area for concrete block, concrete tile and clay tile, concrete products will still have significant and easily proven advantage of strength in the wall. It will be remembered that only recently, in the series of tests which follow, it was conclusively proven that the concrete units tested developed over 64.2% of their average individual strength when tested in a pier, while comparable clay units developed about in a pier 23% of the average strength of individual units.

CONCRETE BUILDING TILE ARE MORE EFFICIENT THAN CLAY TILE

Tests made on clay and concrete tile walls by the Structural Materials Research Laboratory, Lewis Institute, Chicago, all tile laid in 1:3 portland cement mortar:

TABLE "B"

Wall No.	Kind of Tile	Dimensions of Wall in Inches W.	L.	H.	Ave. Comp. Strength of Individual Tile in lbs. per sq. in. of Gross Area	Ave. Comp. Strength of Wall in lbs. per sq. in. of Gross Area	Efficiency of Wall Section Compared with Single Unit %
1.	Concrete	8.0	24.0	15.2	1350	670	50
2.	Concrete	7.9	24.5	15.2	1350	740	55
3.	Concrete	11.9	16.0	15.3	1350	800	59
4.	Concrete	11.9	12.0	15.5	1350	1080	80
5.	Concrete	7.9	12.0	15.5	1350	1040	77
						Average	64.2
6.	Clay	8.4	26.4	17.0	630	120	19
7.	Clay	8.4	26.4	15.9	630	170	27
						Average	23

TABLE "A"
HOLLOW BUILDING TILE CODE REQUIREMENTS

	Percentage Percentage	Ult. Strength V. Gr.	Ult. Strength H. Gr.	Unit Stress V. Gr.	Unit Stress H. Gr.	Foundation of Voids	Absorption	Total Height of Walls Permitted	
Hollow Building Tile Association	12	700	700	—1/10—		55	Yes	5-story	55 ft.
National B. F. U.	15	1,200	800	120	80	..	Yes	4-story	55 ft.
New York City	15	1,200	800	100	50	..	Yes	....	40 ft.
Chicago	..	....	....	*350	..	..	No	4-story	..
Philadelphia	10	*3,000	....	..	..	50	No	3-story	..
St. Louis, Mo.	12	*3,000	....	..	..	..	...	....	..
Boston	..	....	....	..	..	..	No	3-story	..
Pittsburgh	12	1,800	900	150	75	55	Yes	....	..
Baltimore	12	700	700	—1/10—		55	Yes (Filled)	....	..
Detroit	12	*2,000	....	*250	..	..	Yes	....	30 ft.
Cincinnati	..	....	....	..	..	..	Yes	3-story	37 ft.
Cleveland	10	....	....	*200	..	..	Yes	....	..
Washington, D. C.	15	1,200	800	120	80	55	No	....	40 ft.
New Orleans	..	....	....	..	..	..	...	....	..
Nashville	15	1,200	800	120	80	..	Yes	4-story	55 ft.
Newark, N. J.	..	*3,000	....	*300	..	..	No	3-story	..
San Francisco	12	....	*1,500	..	*150	..	No	....	..
Milwaukee	8	700	700	70	70	55	Yes	6-story	60 ft.
Minneapolis	..	....	....	*250	..	..	No	4-story	..
State of Wisconsin	12	700	700	—1/10—		55	No	3-story	45 ft.

*Net.

NOTE.—V. means Vertical Web Tile. H. means Horizontal Web Tile.

Where to Have Tests Made

College and Commercial Laboratories Equipped for Testing Concrete Block and Drain Tile[1]

(An asterisk [*] indicates a Commercial Laboratory)

ALABAMA

Birmingham
*Pittsburgh Testing Laboratory, 215 Clark Building, W. L. Caldwell, manager.

ARIZONA

Tucson
University of Arizona, Dept. of Civil Engineering, Prof. F. C. Kelton. (Maximum testing capacity, 100,000 lbs.).

CALIFORNIA

Berkeley
University of California, Dept. of Civil Engineering, Prof. C. T. Wiskocil. (To make only such tests as commercial laboratories in San Francisco are not equipped to handle.)

Fresno
*Twining Laboratories, Merced and L streets.

Los Angeles
*Smith, Emery & Co., 651 Howard St.

Pasadena
California Institute of Technology, R. R. Martel, Instructor in Civil Engineering.

San Francisco
*Eaton Laboratories.
R. E. Noble & Co.
*Robert W. Hunt & Co., 251 Tearney street.
*Hildreth & Co., Humboldt Bank Bldg.
*Smith, Emery & Co., 651 Howard St.

Stanford University
Leland Stanford Junior University, Dept. of Civil Engineering, Prof. C. Moser.

COLORADO

Boulder
University of Colorado, Dept. of Civil Engineering, Prof. W. C. Huntington.

Colorado Springs
Colorado College, Dept. of Civil Engineering, Prof. F. M. O'Key.

Golden
Colorado School of Mines, Victor C. Alderson, Pres.

CONNECTICUT

New Haven
Yale University, Dept. of Engineering Mechanics, Prof. G. J. Tilden.
Sheffield Scientific School of Yale University, Dept. of Civil Engineering, Winchester Hall, Prof. R. H. Suttie.

DELAWARE

Newark
Delaware College, Dept. of Civil Engineering, Prof. R. W. Thoroughgood.

GEORGIA

Atlanta
Georgia School of Technology, Prof. F. C. Snow, Laboratory Director.

IDAHO

Moscow
University of Idaho, College of Engineering, C. N. Little, Dean.

ILLINOIS

Chicago
Armour Institute of Technology, 330 Federal street, G. F. Gebhardt, Mech. Engr.
*Modjeski & Angier, 610 Blue Island avenue.
*Robert W. Hunt & Co., 445 N. Sacramento.
*Gulick-Henderson Co., Manhattan Bldg.
Lewis Institute, Madison and Robey streets, Prof. D. A. Abrams.
*Hildreth & Co., Monadnock Block.

Urbana
University of Illinois, Prof. A. N. Talbot.

INDIANA

Lafayette
Purdue University, College of Engineering, Prof. W. K. Hatt.

Terre Haute
Rose Polytechnic Institute, Dept. of Civil Engineering, Prof. H. A. Thomas.

IOWA

Ames
Iowa State College, Prof. Anson Marston, Dean of Engineering.

Des Moines
*Patzig Testing Laboratory, Monroe L. Patzig.

KANSAS

Lawrence
University of Kansas, Dept. of Mechanics, Prof. H. A. Rice.

Manhattan
Kansas State Agricultural College, Road Materials Laboratory, Prof. R. A. Seaton.

KENTUCKY

Lexington
University of Kentucky, Dept. of Civil Engineering, Prof. D. V. Terrell.

LOUISIANA

New Orleans
The Tulane Univ. of Louisiana, W. B. Gregory, Prof. of Experimental Engrg.

MARYLAND

Baltimore
The Johns Hopkins University, Dept. of Engineering, J. T. Thompson.
*The Meade Laboratories, Inc., 11 E. Fayette street.
*Hildreth & Co., 726 Woodbourne avenue.

College Park
Maryland State College, School of Engineering, M. A. Pyle. (Maximum testing capacity, 100,000 lbs.).

MASSACHUSETTS

Boston
*J. R. Worcester & Co., 79 Milk street.
Wentworth Institute, Huntington avenue and Ruggles, Walter Voss.
*The Thompson & Lichtner Co., 136 Federal street.

Cambridge
Mass. Inst. of Technology, Cambridge, 39.

Springfield
*The Emerson Laboratory, 145 Chestnut street.

Watertown
Watertown Arsenal.

Worcester
Worcester Polytechnic Inst., Dept. of Civil Engineering, Prof. F. W. Roys.

MICHIGAN

Ann Arbor
University of Michigan, State Highway Laboratory, John H. Bateman, Director.

Detroit
*Perry Testing Laboratory, foot of Third street. (300,000 lb. Universal).
*Detroit Testing Laboratory.

MINNESOTA

Duluth
*Minnesota Testing Laboratories, Inc., Glencoe Building.
*Duluth Testing Laboratory.

Minneapolis
The University of Minnesota, Experimental Engrg. Building, G. A. Maney.

St. Paul
*Quincy A. Hall, Pioneer Building.

MISSOURI

Columbia
University of Missouri, School of Engineering, Prof. H. A. LaRue.

Kansas City
*Kansas City Test. Laboratory, Inc., 1013 Grand avenue.

Rolla
Missouri School of Mines, Dept. of Civil Engineering, Prof. E. S. McCandliss.

St. Louis
Washington University, Dept. of Civil Engineering, Prof. J. L. Van Ornum.
*Robert W. Hunt & Co., Syndicate Trust Building.

MONTANA

Bozeman
University of Montana, Dept. of Civil Engineering, Prof. Leon D. Conkling.

NEBRASKA

Lincoln
The University of Nebraska, Dept. of Applied Mechanics, G. R. Chatburn, Chairman.

NEW JERSEY

Hoboken
Stevens Institute of Technology, Carnegie Lab. of Mech. Eng., Robert M. Anderson.

New Brunswick
Rutgers College, Dept. of Civil Engineering, S. A. Stephenson, Jr. (Maximum testing capacity, 100,000 lbs.).

Newark
*J. W. Howard Laboratory, 234 Mt. Prospect avenue.

NEW MEXICO

State College
College of Agriculture and Mechanical Arts, Dept. of Civil and Irrig. Engrg., J. W. Jourdan. (Maximum testing capacity, 60,000 pounds.)

NEW YORK

Ithaca
Cornell University, College of Civil Engineering, Prof. H. H. Scofield.

Lackawanna
*Babcock Testing Laboratory.

New York
*Robert W. Hunt & Co., 90 West street.
*Pittsburgh Testing Laboratory, 50 Church street, W. F. Hammett, Mgr.
*Hill & Ferguson, 112 East 19th street.
*Hildreth & Co., 15 Broad street.
*C. F. McKenna, Ph. D., Hudson Terminal Building, 50 Church street.
Cooper Union, Dept. of Civil Engineering, Hewitt Building, Prof. F. E. Foss. (Capacity, 200,000 lbs.).
Columbia University, Testing Laboratory, Albin H. Beyer. (400,000 pounds.)

Potsdam
Clarkson College of Technology, Dept. of Civil Engineering, Prof. Frederick C. Wilson.

Schenectady
Union College, Dept. of Civil Engineering, Prof. Frank P. McKibben.

Syracuse
Syracuse University, Experimental Engineering Dept., Lockwood N. Street.
*Girard M. Parce, 121 E. Seneca street.

Troy
Rensselaer Polytechnic Institute, Prof. T. R. Lawson.

University Heights
New York University, Walter S. L. Cleverdon, Supervisor of Property.

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[1] Published through Courtesy of the Portland Cement Association.

NORTH CAROLINA

Asheville
*C. S. Waddell, Patten avenue.

NORTH DAKOTA

Agricultural College
North Dakota Agricultural College, Dept. of Civil Engineering, Prof. R. H. Slocum.

OHIO

Akron
University of Akron, College of Engineering, R. C. Durst.

Cleveland
Case School of Applied Science, Frank H. Neff.
*Watson Engineering Co., Leader-News Building.
*The Cleveland Testing Laboratory Co., 511 Superior building.
*Crowell & Murray, Perry-Payne Building.
*Osborn Eng. Co., Osborn Building.

OKLAHOMA

Norman
The University of Oklahoma, College of Engineering, Prof. James C. Davis. (Maximum testing capacity, 100,000 lbs.)

OREGON

Corvallis
Oregon State Agricultural College, Dept. of Mechanics and Material, S. H. Graf.

Portland
*E. W. Lazell, Ph. D., 537 Railway Exchange Building.
*Hildreth & Co., 537 Railway Exchange building.

PENNSYLVANIA

Allentown
*Allentown Testing Laboratory, Fourth and Linden streets, McCready, Ernest B., Prop.

Gettysburg
Pennsylvania College, Dept. of Civil Engineering, Prof. Frank H. Clutz. (Maximum testing capacity, 100,000 lbs.)

Philadelphia
*Henry S. Spackman, 2024 Arch street.
*Booth, Garrett & Blair, 404 Locust street.
*Hildreth & Co., 3754 Main street.

Pittsburgh
*Lehigh Valley Testing Laboratory, 1608 Benedum Trees Building.
*Gulick & Henderson Co., 525-9 Third avenue.
*Floyd Rose & Co., Fulton Building.
University of Pittsburgh, School of Engineering, Prof. J. Hammond Smith.
*Hildreth & Co., Highland building.
*Pittsburgh Testing Laboratory, Seventh and Bedford avenue, P. J. Freeman, Engr.
*Robert W. Hunt & Co., Monongahela Bank Building.

South Bethlehem
Lehigh University, Dept. of Civil Engineering, Prof. R. J. Fogg.

State College
Pennsylvania State College, Dept. of Civil Engineering, Prof. E. D. Walker.

SOUTH DAKOTA

Vermilion
University of South Dakota, Dept. of Civil Engineering, Prof. J. Maughs Brown.

TENNESSEE

Knoxville
University of Tennessee, College of Engineering, Prof. N. W. Dougherty. (Maximum testing capacity, 100,000 lbs.).

TEXAS

Forth Worth
*The Fort Worth Laboratories, 204½ Houston street, F. B. Porter, President.

Galveston
*Galveston Laboratory, Felix Paquin, Chemist.

UTAH

Salt Lake City
State Testing Laboratory, State Capitol, Fred Sutton.
*Salt Lake City Testing Lab.

VERMONT

Northfield
Norwich University, Dept. of Civil Engineering, Prof. A. E. Winslow.

VIRGINIA

Norfolk
*Norfolk Testing Laboratory, 109 West City Hall avenue, Burton J. Ray, Chemist in charge.

Richmond
*Froehling & Robertson.

WASHINGTON

Seattle
University of Washington, Dept. of Civil Engineering, Ira L. Collier.
*Hildreth & Co., 116 Yesler Way.

WEST VIRGINIA

Morgantown
West Virginia Univ., College of Engrg., Dean C. R. Jones.

WISCONSIN

Madison
The University of Wisconsin, College of Mechs. and Engrg., Prof. M. C. Withey.

Milwaukee
Marquette University, College of Engineering, J. C. Pinney, Jr., Dean. (Maximum testing capacity, 50,000 lbs.)

CANADA

Montreal, Que.
*Canadian Inspection and Testing Laboratories, Ltd.
*Robert W. Hunt & Co., McGill Building.
Dominion Engrg. & Inspection Co., B. W. Seton, Mgr.

Toronto
*Canadian Inspection and Testing Co., Manning Arcade Annex, R. Robertson Deans, Mgr.
Dominion Engrg. & Inspection Co., B. W. Seton, Mgr.

Vancouver, British Columbia
*Canadian Inspection and Testing Laboratories, Ltd.

Winnipeg, Manitoba
*Canadian Inspection and Testing Laboratories, Ltd.
Dominion Engrg. & Inspection Co., B. W. Seton, Mgr.

Government Report on Products Business

A report of the United States Geological Survey[1] shows a great variety of concrete products now being manufactured. Besides the main products—block, brick, silo blocks and staves, and architectural stone—the report lists the following classifications:

Ashpit blocks, baseboards, bier blocks, building vaults, burial vaults, cesspool covers, chimney blocks, cistern blocks and covers, columns, copings, culvert tile, curbing, door and window sills, drain tile, fence posts, fire blocks, floor tile, flower boxes and urns, garden ornaments, hog troughs, laundry trays, lawn seats, lintels, meter boxes, oil plugs, ornamental balls, pier blocks, caps, poles for street signs, porch columns, reinforced culvert pipe, roof tile, sewer pipe, sidewalk blocks, sills, urns, vases, veranda posts, water troughs, and well curbing and tile.

The number of concrete block plants doing business on a stable basis is increasing. This is apparent from the increasing number of firms reporting on the questionaire sent out by the Geological Survey—609 firms in 1917, 920 in 1918, 1,511 in 1919, and 1,268 in 1920.

According to the data gathered by the Survey, the total value of all concrete products represented in 1920 showed an increase of 25% over 1919, but the total quantity, except miscellaneous material not measurable, showed a decrease of 28%.

Ohio, Minnesota, and Indiana ranked first, second and third in the quantity of products. Iowa ranked first in the value, on account of the $800,000 production of drain tile. Architectural concrete stone used in facing and trimming buildings increased about 10%. There was also an apparent increase of 44% in value and an increase in value per cubic foot from $1.98 in 1919 to about $2.60. New York led in the production of this material, followed by Masachusetts, Connecticut, and Missouri.

The sales of concrete building blocks in the United States, reported to the Survey, were 10,851,866 cu. ft., valued at $4,720,672. There was a decrease of 30% in quantity and 10% in value over 1919, although the average value per cubic foot increased from 33 cents to nearly 44 cents. The greatest sales were made in Ohio, Minnesota, Indiana, Nebraska, and Illinois, the output in each of these states being more than 1,000,000 cu. ft.

The production of concrete brick showed an increase of 7% in quantity and 50% in value over 1919. The average value increased from 44 cents to 61 cents per cu. ft., or from $18 to $31 a thousand. Ohio led, with a production of 31,000 cu. ft., followed by Florida with 13,000 cu. ft.

The total quantity of concrete silo staves and blocks decreased 17%. Their average value was 84 cents per cubic foot.

The mixtures used vary from 3 to 6 parts of aggregate to 1 part of cement. Of 393 mixtures used in Ohio, Indiana, Illinois, Michigan, Minnesota, and Iowa, 154 were 1 to 5; 141 were 1 to 4. Producers in Iowa seem to use richer mixtures than those in other states, for of 105 mixtures reported from Iowa, 56 were 1 to 4, and 25 were 1 to 3.

According to conservative estimates made by the United States Geological Survey from the incomplete returns available April 1, the quantity of gypsum mined in the United States in 1921 was approximately 2,870,000 short tons, as compared with 3,129,142 tons in 1920. The combined value of the crude and calcined gypsum sold was approximately $20,820,000, as compared with $24,533,065 in 1920.

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[1] "Concrete Stone and Concrete Blocks in 1920," by R. W. Stone, from *Mineral Resources of the United States*, 1920, Part II.

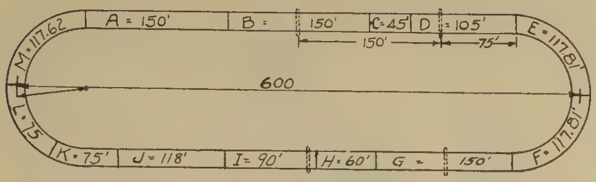


FIG. 1—LAYOUT OF TEST HIGHWAY, PITTSBURG, CAL.

Concrete Highway Test at Pittsburg, California

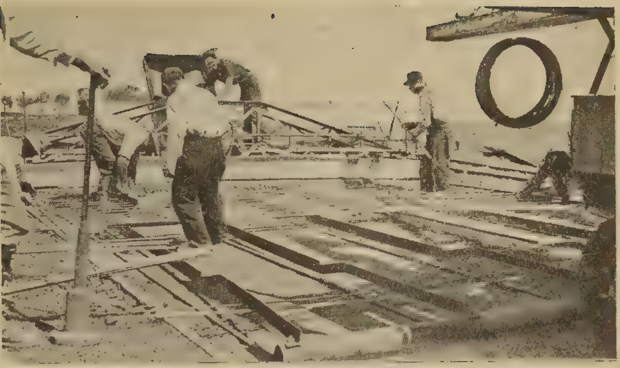
BY CHARLES GEIGER
SAN FRANCISCO

An eliptically shaped roadway, 18 ft. wide and 1,371 ft. long, of plain and reinforced concrete, has recently been constructed at Pittsburg, California, under the direction of the Columbia Steel Co., which was tested by operating loaded motor trucks over it to determine by observation, under the same conditions of wear and on the same subgrade, the relative merits of different materials and types of design, and at the same time to develop, if possible, an improved type of plain and reinforced concrete pavement. There were 13 sections of various cross sections, several of which were reinforced with a special steel of very high tensile strength, having a little more than twice the strength of the grades now available, which is expected to strengthen the slab as much as would be feasible with an excessive amount of commercial grade steel.

The pavement when completed was kept under water for 14 days, and traffic was kept off of it for 70 days after placing. The crown of the highway is 1½ in. throughout. The turns are super-elevated to enable truck operation at 25 miles an hour with safety. The mix for twelve of the sections is 1:2:4, and the other section a 1:2½:4 mix, on account of Prof. Abram's advocacy of a greater percentage of fine aggregate.

A novel method was employed to insure accurate placement of the reinforcing. This is shown in Fig. 2. A cradle was built of angle irons and pipes, anchored to a 4 in. pipe 18 ft. long. The lower layer of reinforcing was supported by pipes flattened on the under side, and the upper layer was supported by the angle irons. The 18 ft. pipe was used as a pull bar, being attached to the concrete mixer, and pulled forward as the mixer advanced, leaving the steel reinforcing in place.

A Multi-Foote 5-sack capacity caterpillar paver, with bucket discharge, was used. This was also equipped with a batch box derrick for charging material into the skip of the mixer. Sand and gravel were hauled from cars and barges by motor truck. The material was picked up from the stock pile by two wagon loaders, a Spears-Wells and a Barber-Greene. A 24-in. gauge industrial track was laid on the outer shoulder around the test highway, and the material boxes were hauled over these tracks by a Burton[3] gasoline 9-ton locomotive. Koppel car trucks were used to carry the batch boxes, each truck carrying two batch boxes to a load. The concrete was tamped and finished by a Lakewood tamper, A Carr subgrader was used to finish the subgrade.



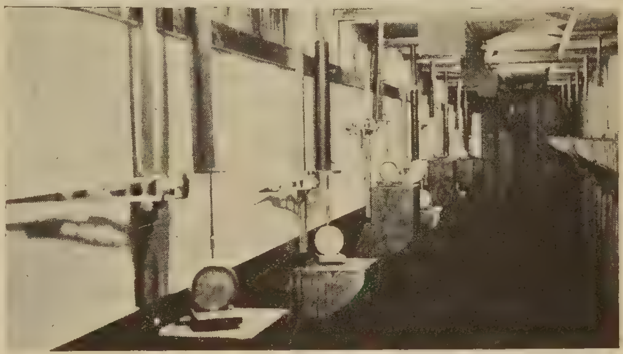


FIG. 2—SHOWING THE TEMPLATE FOR PLACING REINFORCING

FIG. 3—CONCRETE BLOCKS USED FOR REPAIRING

FIG. 4—VIEW OF INTERIOR OF TUNNEL

Following are the estimated costs per mile, exclusive of grading and preparing sub-grade, of each of the 13 sections of highway. They are listed in order of cost, from lowest to highest.

Section	Concrete Per cu. yd.	Cost Per Mile	Steel Cost Per Mile	Loose Rock Grade Per Mile	Total Cost Per Mile
B. 5 in.	$18.20	$26,700	$1,500	......	$28,200
H. 5 in.	18.20	26,700	1,800	......	28,500
L. 5 in.	18.20	26,700	4,125	......	30,825
J. 6 in.	17.10	31,770	.....	......	31,770
K. 5 in.	18.20	26,700	5,175	......	31,875
I. 5 in.	18.20	30,850	1,800	......	32,650
A. 5 in.	18.20	26,700	1,500	$5,475	33,675
D. 6 in.	17.10	30,100	4,125	......	34,225
C. 6 in.	17.10	30,100	4,125	......	34,225
G. 6 in.	17.10	30,100	4,125	......	34,225
M. 7 in.	16.25	39,020	.....	......	39,020
F. 8 in.	15.60	40,680	.....	......	39,020
E. 8 in.	15.60	42,040	.....	......	42,040

Before building the test highway, Lloyd Aldrich, consulting highway engineer, and J. B. Leonard, consulting structural engineer, in charge of the test, sent questionnaires to federal, state and county highway engineers and to consulting engineers in private practice, and embodied their suggestions in the test highway.

For the first time in the history of concrete road construction, exhaustive observations were made on the under side of the concrete slabs, to determine the effect of various truck loads and speeds on the flexure of the slabs, as well as of the subgrade. For this purpose four tunnels were built under the concrete highway, having their roofs a little over 3 ft. below the top of the subgrade.

Steel rods were embedded in the concrete and in the subgrade. These extended down into the tunnel, where they were hooked up with dials that recorded deflections to thousandths of an inch.

Of the 13 sections, three are in general use in the western part of the United States. Sections A and B are California Highway Commission standards, and are identical in all respects except for the prepared rock subbase under Section A. Section J is commonly referred to as the "Arizona standard," and, it is said, was made a part of the test highway at the request of the people of that state.

Section A is 5 in. thick, 18 ft. wide, 150 ft. long, reinforced with ⅜ in. structural grade steel bars, placed in the center of slab 18 in. on centers.

Section J is 6 in. thick, 9 in. thick at edges, 18 ft. wide, 118 ft. long, with no reinforcement.

Section C is 6 in. thick, 18 ft. wide, 45 ft. long, reinforced with ⅜ in. special grade steel bars (approximately 70,000 lbs. tensile strength, twice that of ordinary steel), placed in top and bottom of slab diagonally, on 9 in. centers.

Section D is 6 in. thick, 18 ft. wide, 105 ft. long, reinforced with ⅜ in. special grade steel bars, placed in the top and bottom of slab diagonally, on 9 in. centers.

Section E is 8 in. thick, 18 ft. wide, 118 ft. long, no reinforcement, cold joint longitudinally in the middle, and four inverted curbs 8 in. deep.

Section F is 8 in. thick, 18 ft. wide, 118 ft. long, no reinforcement, two inverted curbs, 12 in. deep.

Section G is 6 in. thick, 18 ft. wide, 150 ft. long, reinforced with ⅜ in. special grade steel bars, placed in the top and bottom, 5½ in. on centers.

Section H is 5 in. thick, 18 ft. wide, 60 ft. long, reinforced with ⅜ in. structural grade steel bars, placed in center of slab, 18 in. on centers. There is a cold joint longitudinally in the middle.

Section I is 5 in. thick, 18 ft. wide, 90 ft. long, reinforced with ⅜ in. structural grade steel bars, placed in the center of the slab, 18 in. on centers, with cold joint longitudinally in the middle, and two inverted curbs 7 in. deep.

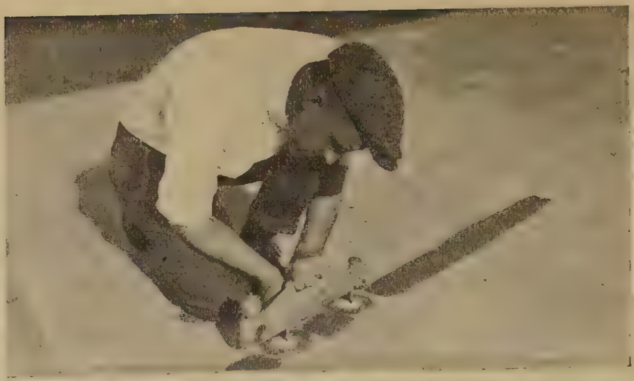
Section K is 5 in. thick, 18 ft. wide, 75 ft. long, reinforced with ⅜ in. special grade steel bars, placed in top and bottom, 7½ in. on centers.

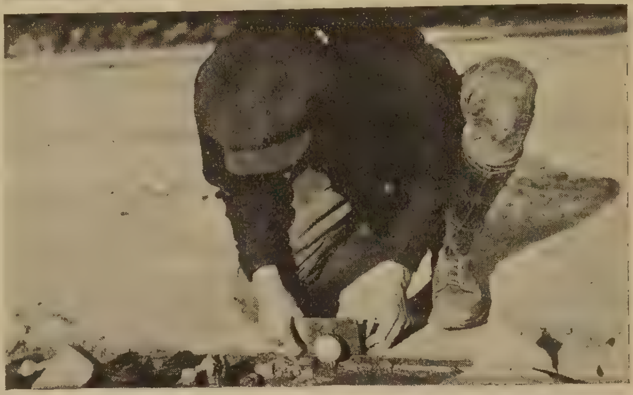
Section L is 5 in. thick, 18 ft. wide, 75 ft. long, reinforced with ⅜ in. special grade steel bars, placed in top and bottom of slab, diagonally, 9 in. on centers.

Section M is 7 in. thick, 18 ft. wide, 118 ft. long, no reinforcement, with corrugated iron joint longitudinally in the middle, with four inverted curbs 8 in. deep.

Altogether, the trucks traveled 96,000 miles from November 9, 1921, to January 28, 1922, when the traffic was stopped, carrying over each section of the highway the same load—3,668,100 tons, which is equivalent to about 10 years' travel on the ordinary California highway. This test traffic was naturally far more intensive than actual traffic on any highway, in order to bring about destruction of the pavement within a reasonable period of time. An additional factor in shortening the period was the practice of increasing the loads from time to time. Towards the last of the traffic tests, seventeen of the trucks were operating over the highway with a gross load of 24,500 lbs., and seven trucks with a gross load of 29,000 lbs.

As the tests proceeded disintegration took place in small areas which at first caused little concern, but which, as time went on, gave increasing trouble until in January the maintenance of the test highway was a serious problem. As the weaker sections were broken up, the breaks were repaired, as shown in Fig. 3. The broken concrete was removed and an excavation made to a depth of 16 in. below the surface of the concrete pavement. Timbers 4 in. square were placed on the bottom of the excavation, and on these were placed timbers 12 in. square, thus bringing the top of the timbers on a level with the surface of the concrete pavement. In one break concrete blocks about 6 in. thick were used in making repairs. This proved very satisfactory.





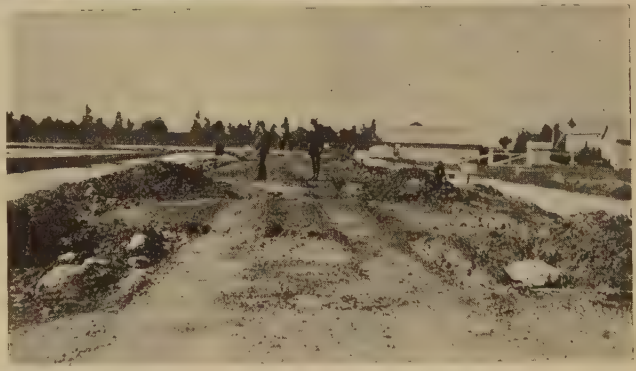


Fig. 5—Use of Extensiometer, to Measure Expansion Due to Cracks

Fig. 6—Ames Dial Used in Determining Upward Movement of Edge of Slab

Fig. 7—Showing Condition of Section B Shortly Before Traffic Was Discontinued

Accompanying illustrations show the condition of some of the sections shortly before the traffic tests were stopped. An analysis of the several sections shows that the three heaviest sections—that is, those having the greatest minimum thickness of concrete, stood up the best of any. These sections are E, F, and M, the first two having a minimum thickness of 8 in., and the other 7 in. This study also shows that the thinner slabs—those of 5 in. thickness—have been the ones least able to stand the traffic. Of the six sections in this class, four—A, B, H, and I—stand out prominently as failures. The degree of failure of the intermediate sections, or those of 6 in. minimum thickness, is between the other groups. All of this seems to indicate that the thicker the concrete itself, the better able it is to withstand the destructive action of traffic.

The two California standard roads—Sections A and B—were almost complete ruins. The Arizona standard section (Section J) apparently was in excellent condition—as good as California roads when they are first opened to traffic.

The Arizona standard calls for 6 in. concrete; the best California standards (Sections A and B) call for only 5 in. The use of steel reinforcement in the latter case, believed to be capable of making up for an inch less of concrete, apparently fails to accomplish the purpose.

There is evidence to show that the disintegration of the concrete is as bad where reinforcement is used as where none at all is used. Then again, other evidenec would indicate that the permanency of thin slabs, if a sufficient quantity of steel were used, would be increased materially. Sections K and L are both 5-in. slabs, and are identical with Sections A and B, the two State Highway standard sections, except that they have about three times the reinforcement. Sections K and L stood up very much better than A and B.

The cost of one extra inch in thickness of concrete is about the equivalent of 50 tons of steel reinforcement per mile. Consequently, the 5-in. sections of K and L, which have 69 and 55 tons of steel per mile, are somewhat higher in cost than the 6-in., Section J, which has no reinforcement. The idsintegration in Section J is less than in either of the other two sections, indicating that from a standpoint of economy of construction and durability that the thicker unreinforced section is the better. Both Sections G and J are 6-in. sections. The disintegration in Section G is much more noticeable than in J, and yet it has 69 tons of steel per mile, while J has none. These evidences and studies seem to indicate that steel reinforcement adds strength to the concrete road slab, but that the same extra cost put into extra thickness of concrete is more effective.

A moving load test, a static load test, and an impact load test were made, and the results recorded in the tunnel on the Ames dials placed under the nine steel rods embedded in the concrete pavement.

In making impact tests, a motor truck carrying a total load of 14,500 lbs., was driven over planks of varying thickness, being placed across the test track directly over the roof of the tunnel.

The deflection of the concrete slab at nine different points was recorded. The wheels on one side of the truck were run directly over rod No. 7, and the wheels on the other side of the truck were run over the pavement between rods 4 and 5. A permanent record of the slab deflection under these impact loads is made by means of recording pens.

When the truck passed over a plank having a 2-in. fall the pavement under the truck wheel directly over rod No. 7 deflected downward more than .020 in. In making these impact tests, the truck was driven over the planks placed across the pavement at from ten to twelve miles an hour. These impact tests show the great strain on concrete pavement when a truck wheel passes over obstructions of any sort.

An interesting fact, brought out when the moving load test records and the static load test records were compared, was that the deflection of a slab is less when a motor truck is traveling at 12 miles an hour than when the same truck is standing still.

The pavement over the observation tunnels was marked off into foot sections. These markings extend for a distance of 25 ft. or more on either side of the tunnel. A loaded truck was run slowly toward the tunnel, stopping every 2 ft. long enough to permit the observers at the Ames dials to observe the slab deflection. It was discovered that when the front wheels of the truck came within ten feet of the tunnel, the dials began to register. The registrations became greater as the truck approached the tunnel, and when the rear wheels were directly over the tunnel the greatest deflection was registered, the greatest deflection, 0.005 in., being at rod No. 7, which was directly under one of the truck wheels. The truck was then driven away from the tunnel, stopping every 2 ft., until the dials ceased registering when the rear wheel of the truck had reached a point 40 ft. from the top of the tunnel.

The temperature of the slabs was taken by immersing a thermometer in holes bored into each of the sections to points near the top, bottom and middle of the slab, and filled with mercury. When not in use, the holes were securely corked.

Car Track Paving at Street Intersections

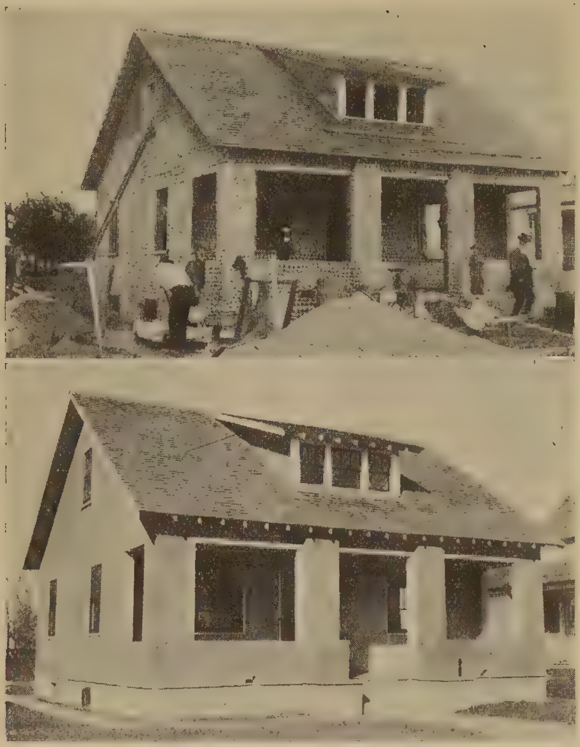
On Clifton Boulevard, Cleveland, the tracks of the Cleveland Street Railway Co. are laid parallel to and a few feet outside the curb line of the Boulevard. At street intersections the problem of providing an economical, durable type of paving was met by installing precast concrete slab crossings. The first crossing was installed in July, 1920, and since then thirty crossings have been improved in this manner.

Only the area between the rails was paved with concrete slabs, the paving of the street proper being extended to the outside edge of the rail on both sides of the track. The crossings are 30 ft. long and consist of three lines of precast concrete slabs, each line being made up of two slabs, one 12 ft. long and one 18 ft. long. These are placed so that the joints are staggered.

The center row of slabs is 18 in. wide and the two rows adjacent to the rails are 20 in. wide. The outside edges of the slabs touching the rails were grooved to provide a flangeway. The slabs were not fastened to the ties, nor were the edges protected in any way except to project the end under the head of the rail. The space between the slabs, approximately ⅜ in., was filled with tar.

Each slab was reinforced with eight ¾-in. square twisted bars. These were placed in two layers, near the top and bottom of the slab. Reinforcement was placed principally to insure safety in handling. The thickness of the slabs was 1 in. less than the height of the rail. Concrete was mixed in the proportion of 2:2:3, using portland cement, sand and granite or limestone chips. The slabs were cured for 30 days before installing. Three men were able to fabricate one complete crossing per day, including stripping forms and assembling them for the next job. The cost of the materials and labor for each crossing amounted to $62.

The slabs were placed on a thin cushion of sand, spread over the ties to a thickness of 1 in., and carefully leveled. A crossing was installed by eight men with a derrick in about two hours. The slabs were handled by means of a chain placed around their centers. The crossings were manufactured and installed under the direction of C. H. Clark, maintenance of way department of the street railway company.—*Concrete Highway Magazine.*



Concrete and Cordwood House Before and After Stuccoing

Formless Construction Using Cordwood and Concrete

By M. B. Lagaard
Assistant Professor Structural Engineering
University of Minnesota, Minneapolis, Minn.

The vast field for concrete which lies in the construction of fireproof dwellings has long held the attention of the concrete builder, and a considerable number of construction methods have been used to secure the advantage of fireproof construction with a reasonable outlay of funds.

One system which seems to have a remarkable advantage because of its low cost (in some timbered sections—Editor), has recently come to the attention of the writer and will undoubtedly prove of interest to the building profession. This system of construction was developed by L. N. Butler, of Grand Forks, North Dakota, and enables one to build the wall for a dwelling without the use of forms. To accomplish this, wood is used in connection with the concrete as an integral part of the wall, and the wall is built up much in the same manner as a brick wall. The wood itself, while it displaces its volume of concrete and produces a lighter wall, is not calculated to carry any part of the load.

The method of construction consists of placing a layer of fresh concrete as a footing for the wall, and upon this placing pieces of wood across the thickness of the wall and spaced about 2 in. apart. The diameter of the pieces is about 2 in., and the length equal to the thickness of the wall. After these pieces have been placed a fresh layer of concrete is placed upon the wood to fill in between the pieces, and thus form a continuous column of concrete to carry the load. The process is then continued, placing first a layer of wood and then a layer of concrete. The consistency of the concrete is dry, so that it is possible to build up the wall without any stopping in the process of construction. At the same time, this consistency gives an almost ideal water-cement ratio for maximum strength of concrete.

The mixture used contains a volume of coarse aggregate equal to the volume of fine aggregate. Gravel is found to be most suitable as far as workability is concerned. The wood used may be either a hard or soft variety, the latter have a few advantages. It is absolutely essential that the wood be thoroughly saturated at the time it is put into the wall, so that it will not expand after the concrete has partially hardened and cause the wall to crack.

After the wall has become partially dried the wood becomes loosened somewhat from the concrete, leaving a wall consisting of arches and vertical columns to carry the load. In house construction the face of the wall, with the ends of the wood pieces exposed, is plastered and stuccoed on the outside and furred, lathed, and plastered on the inside. Nine houses of this type have already been constructed, some of which have been in service for four years, and the results so far are very promising. The insulating qualities of the wall appear to be good. The accompanying illustrations show a house before and after stuccoing.

This method, which was first used in house construction, has now been applied to small garages and farmers' warehouses, and a remarkable saving in cost has been noted here. Tests are now being conducted to secure accurate data regarding the various properties of this construction, so as to apply this method to buildings two or more stories in height.

White Concrete Block Mark Safety Zones in Portland, Oregon

Marking Safety Zones With White Faced Blocks

Portland, Oregon has marked its safety zones and crosswalks with lines of concrete blocks, six inches square and two feet long. These blocks are precast with an ordinary body mix and a facing mix of medusa white cement and sand. They are plainly visible.

It has been estimated that the accumulated coat of four or five years painting amounts to about $2.00 per foot while the total cost of the blocks, cutting pavement, trucking and materials is only about 82 cents per lineal foot.

Pave Colorado Road With Precast Slabs

Difficulty in obtaining water and aggregate at convenient places along the route of a new highway resulted in the highway department of Colorado constructing a single track concrete road of precast slabs, 8 ft. long, 9 ft. wide, and of a uniform thickness of 6 in. This is described in the *Concrete Highway Magazine.*

The slabs were cast at a central mixing station at Casper, Colo. The aggregate and cement were fed to the 2-bag batch Yeager mixer by hand. The mixing water was pumped from the North Platte river through a 1-in. pipe. A 1:2:3 mix was used.

The mixed concrete was transported by buggies to the forms, which were set up on a wooden floor. The concrete was spread by hand and then struck off with a 2 in. by 6 in. wooden screed with a 2-in. steel strip on its base, belted three times and edged. The mixture was made as dry as possible consistent with the necessity of completely inclosing the reinforcement.

A level area of ground was selected for the form floor. This was carefully graded: 2 in. by 4 in. joists, placed 14 in. on centers were set with their tops slightly below the level of the surrounding earth and the intervening space carefully compacted by hand tamping to the top of the joists. One-inch planks were then laid with their finished side uppermost and nailed to the joists. This floor was then covered with roofing paper to prevent seepage of the concrete. The 2 in. by 6 in. wooden forms were fastened on the floor and adequately braced. Each of the four 116 ft. by 20 ft. floors contained space for a double row of 14 slabs, with a 6 in. space between rows and a 2 ft. overlap of platform at the edges.

Slabs were built with both a straight edge joint and an interlocking curve joint. To obtain the latter type edge, plaster of paris headers were cast to the required pattern, painted with liquid paraffin and placed so as to be one side of the form. A slab was cast in this form and then the plaster header removed and the curved end of the slab used as a header form in casting the next slab. The slabs were numbered, to insure a perfect fit from consecutive placing on the roadway. Every fourth slab was made with a straight edge joint in order to provide for expansion joints.

The general style and placement of the reinforcement was the same for all types of slabs. Transverse 5/8 in. round bars were placed 14 in. from each end of the slab and the next two bars, of the same size, placed 10 in. and 6 in., respectively, from the first bar at each end, leaving a space of 36 in. between the center bars. The bars were embedded 2 in. from the bottom of the slab. Under these bars was placed a layer of No. 049 A. S. & W. standard reinforcing steel mesh extending through the entire width and length of the slab. The mesh reinforcement was laid on the floor and pulled up, by hooks into the concrete, after is was deposited. Two pieces of 2-in. galvanized pipe, 5 in. in length, were imbedded in the slab on each side, 2 in. from the bottom and 20 in. from the ends of the slabs. A 5/8 in. round bent rod was placed longitudinally in the slab 3 in. from edges and lapping over the pipe. This reinforcement was designed for for the purpose of preventing breakage or cracking during transportation than to provide sustaining strength against traffic.

In moving the slabs two large iron hooks were inserted into the pipes embedded in each side of the slab, and by means of small hand jacks the slab was raised, placed on rollers, pushed to the edge of the platform and stacked in layers.

Each slab was lifted by a 3-ton Yale & Towne Triplex chain hoist, operated on 3-ton rollers set upon 10 in. I-Beams mounted on A-frames. The slabs were transported to the job on trucks, removed in the same manner and firmly embedded on a thoroughly compacted subgrade cover with a 2-in. sand cushion. The pavement was laid on one side of the 34 ft. roadway with a 1 in. slope towards the outer edge to allow for drainage. The plans call for the addition of an adjoining strip of the same width on the unpaved side of the roadway. Six types of heavily reinforced slabs were made, the contract calling for 50 slabs of each type.

This pavement has given satisfactory service for a year on one of the heaviest traveled highways in the country. It is estimated that over 10,000,000 pounds of freight is carried per month, besides over 100 motor vehicles per day. The wearing surface is in excellent condition, and the slabs show no sign of displacement, although they have been subjected to the extremes of summer and winter.

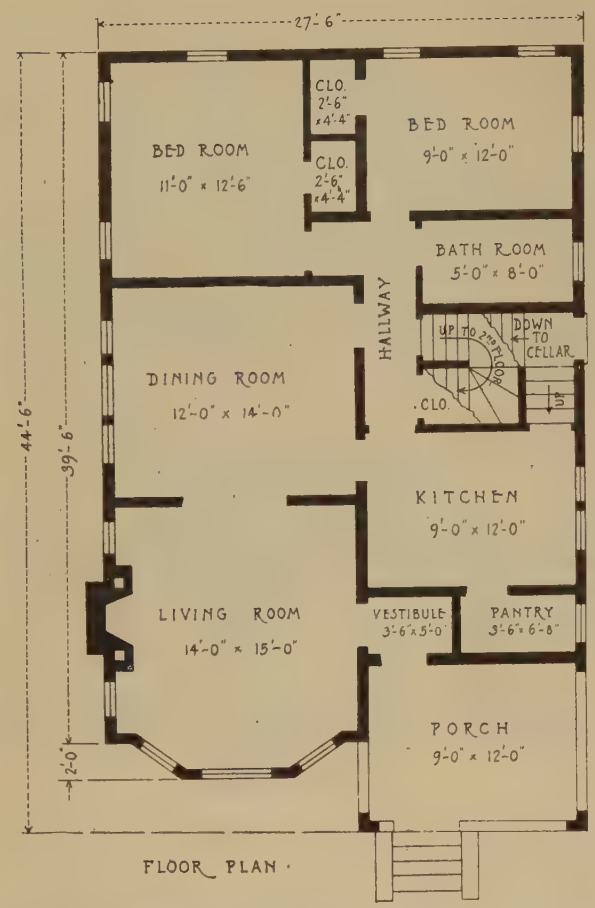
Modern Dehydrating Plant of Block

A good example of a modern dehydrating plant, used to dry fresh fruit, vegetables and other commodities, was recently constructed by F. O. Bohnett, at Campbell, Cal. This is described in the *Concrete Builder.* The main building in which drying takes place is 22 by 48 ft. in ground plan and 12 ft. high. Adjoining the main building is a room 12 by 28 ft. which contains the furnace, boiler and engine.

The main building has a mezzanine floor of concrete 7 ft. 8 in. above the first floor, which extends the full length of the building and across half its width. Upon this floor partitions 3 in. thick are erected 6 ft. 6 in. apart. In each of the compartments formed by these partitions in a 42-in. rotary disk fan. The various fans are belted to a pulley on the end of a drive shaft 28 ft. long, which extends across the building and projects through the wall.

The blowing of hot air over the fruits and vegetables by means of the large power driven fans is the principle on which the dehydrater works. The fans are so located and operated that the temperature and humidity in the room are under control at all times. This is essential to proper drying. Heat is supplied by means of radiators.

The walls of the main building are constructed of Duplex concrete block, with a 3-in. continuous air space between the inner and outer sections. This air space reduces heat losses through the walls, which is an important factor in a dehydrating plant, as it cuts down fuel bills. The units are 2½ in. thick, 8 in. high, and 16 in. long. The inner and outer walls are anchored together by means of metal ties. The units are of a tongue and groove design, so that they interlock when set in the wall. The block are always set with the groove or concave edge up. This concavity is filled with cement grout or mortar before the next course of block is placed, resulting in a strong, tight joint. Although the wall of Mr. Bohnett's plant actually consists of but two sections, each 2½ in. thick and 3 in. apart, there is not the least vibration noticeable when the fans are in full operation.



Plan of Typical House Built of Porete Slabs by Verona Homes Co., Verona, N. J.

Bungalows of Stucco on Porete Slab Base

Slabs of Porete, a portland cement material manufactured by a process which gives it a large proportion of air cells, or pores, uniformly distributed throughout the mass, were recently used in the construction of small houses on the development of the Verona Homes Co., Verona, N. J. The material is formed in precast, reinforced slabs, 31¼ in. by 24 in. by 1 in. One side of the slab is smooth finished, while the other side is rough and porous, giving a good bond for stucco. Because of its porosity, Porete has good insulating qualities.

The frame work of the house is of regulation vertical wood studding, 16 in. o. c., extra care being taken to maintain as even a spacing as possible, in order to accommodate the Porete slabs. Since these are 31¾ in. long, they span two stud spacings and allow a ¼-in. joint. A ¼-in. horizontal joint is also maintained between the slabs by spacing with lath. Before applying the slabs the studs were covered with heavy felt nailed in place.

The slabs are attached to the studs by nailing through the slab with special 8d galvanized nails, with large heads, furnished by the Porete Manufacturing Co. Special washers are also furnished to bridge the slabs at joints. Special care was taken to insure a secure nailing of the slabs. The horizontal joints were broken.

The cellar walls were of poured concrete to 6 in. above ground level, the studding plate set flush with the outside of the cellar wall allowing the Porete slabs to project over the wall to form the water table.

When all the slabs were placed the joints were wetted and then pointed with a 1.3 cement and sand grout and pushed well into the openings in order to insure that all joints were thoroughly filled back to the felt. Galvanized wire mesh was then nailed around all external corners, and when the pointing had thoroughly hardened the base coat of 1:2½ cement-sand stucco was floated on to a thickness of ⅜ in. Colored stucco was used as a finish coat, and applied ¼ in. thick over the floated base coat. Care was exercised to prevent too rapid drying of the stucco coats. The rough porous texture of the Porete slabs afforded a unusually good surface for applying the stucco, as a good bond was secured without undue suction to draw the water out of the stucco.

The houses were placed on lots 50 by 100, and as will be seen from the floor plan, consisted of five rooms and bath, with no bedroom opening from any of the other rooms; in other words, the bungalow was divided into two distinct sections—one consisting of the living room, dining room and kitchen, and the other of the bedrooms and bath. This is an important point in the arrangement of any bungalow.

The houses sold for approximately $5,700.00, exclusive of property. Building and loan mortgages of $3,500.00 were easily secured on each house, because the Building and Loan Association considered the Porete house a good risk, in view of the lessened fire danger and the permanence of the Porete and stucco construction. For this information CONCRETE is indebted to the *Contractor's Atlas.*

As soon as corn is put in a silo it undergoes fermentation, in which lactic and acetic acids are formed. If the silo is air and water tight, these acids will preserve the ensilage. Both acids are of such mild form that they will have no effect on steel or good, dense concrete. Lime is not as resistive to silo acids, the lactic acid combining with the lime to form calcium lactate, which occurs as a white precipitate on the walls of the silo. If it is desired to plaster the inside of the silo, little, if any, lime should be used. It will be more difficult, but more satisfactory in the long run, if cement plaster is applied.

When hydrated lime is used in mortar or concrete it is usually specified as a certain percentage of the cement. While this percentage is in terms of volume, it is also convenient to proportion the hydrated lime by weight. For example, if 10% of hydrated lime is required, this means 10% of the volume of cement. Hydrated lime weighs about 40 lbs. per cubic foot, so that 10% of 40 lbs. would mean that 4 lbs. of hydrated lime is required to each bag of cement (1 bag of cement equals 1 cu. ft.). It is convenient to use a measure or small pail which will contain the required weight of hydrated lime and to add one measureful to each bag of cement used.—*Contractor's Atlas.*

A desire for modern concrete roads and a limited amount of available money decided the Board of Supervisors of Chautauqua County, N. Y., to construct single track concrete roads finished to full width with gravel. This type of road gives almost all the advantages of concrete highways at approximately half the cost. During 1921 the county built 18.4 miles of single track concrete road and intends doubling this amount in 1922.—*Concrete Highway Magazine.*

Joint Used to Join Rails for Pipe Laying

In laying concrete pipe on a Denver job the Lock Joint Pipe Co. found it had to make frequent changes of track lengths on which the pipe laying machine operated, and in order to speed up the changing of the rails a quick assembly joint was devised. The rail joint is disconnected by a few blows of a sledge, and the clamp, two tapered pins, a flat tapered wedge about 4 in. in width, are removed and can be reassembled in two or three minutes. The clamp of this device passes under the end of abutting rails. One side of the clamp fits under the rail head, while the other edge is upturned. Tapered pins pass through the rails and into holes in the upturned edge of the clamp. Under the pins the broad wedge is driven against the rail and the clamp, in order to hold the joint tight.

The pipe laying machine was another interesting feature of the job. It was made up of an A-frame derrick, with a bull wheel mounted on a portable platform 24 ft. square. A 40-h. p. steam hoist was mounted on the platform and used for propelling the platform back and forth over the track, which was made up of three sections of 32 in., 80-lb. rails spiked to 8 in. by 16 in. timbers. Lines from the ends of the booms, lashed to each side of the platform frame and operated from the steam hoist, were used for dragging track sections forward.

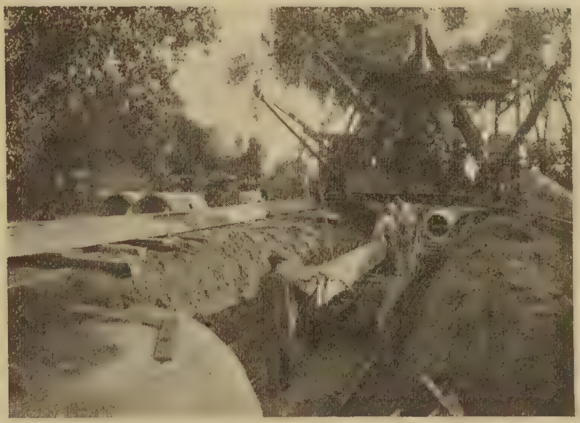


Fig. 1—Showing the Pipe Layer Used on Denver Job

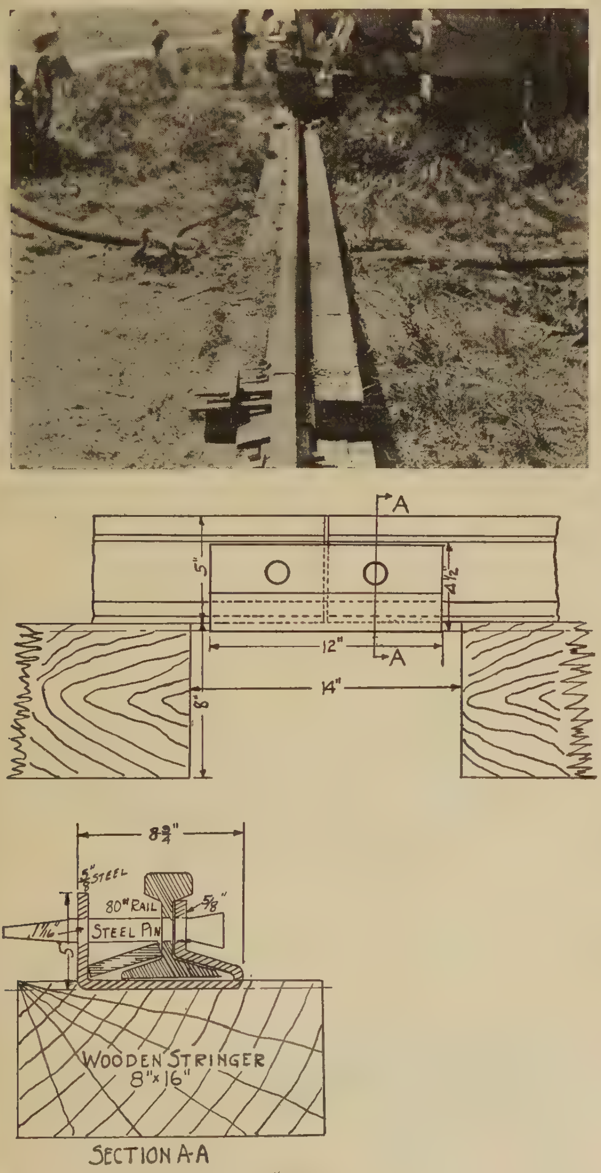


Fig. 2—Details of Rail Joint

J. C. Mitchell, general manager of the Lock Joint Pipe Co., was the originator of the joint.

Cause of Failure of Danville, Ill., Bridge

Deck expansion, inadequate provision for expansion, water trapped behind abutments, and poor quality concrete were the causes of incipient failure of a long concrete bridge at Danville, Ill., last fall, according to Harlan H. Edwards, city engineer, in a recent issue of the *Engineering News-Record*. It is another result of the lightness with which public officials regard the importance of adequate and competent engineering control of the construction of municipal structures. Investigations made during the progress of the repairs to the structure disclosed conditions which showed that certain engineering features of the structure as originally planned were neglected or changed and that the character of the concrete work was not of the high class that it should have been.

The Mill Street bridge is a nine-span reinforced concrete arch viaduct, designed for highway use, having the arch rings of the end spans resting on the abutment walls of the approaches. It was built in 1915 at a cost of about $85,000. As early as three years after the completion of the structure, cracks were noticed in the spandrel columns and arch rings of the east end span, which increased in size and number until action this past summer was imperative to prevent failure of the entire span and probably with it the remaining eight spans of the bridge.

This investigation led to repairs and additional construction. The conditions found during this work corroborated the engineer's assumption that failure in the span was due to the fact that the expansion of the deck was inadequately provided for, and that this was assisted by the double action of sliding and overturning of the abutment wall.

A crack developed between the wingwall of the abutment and the approach wall, measuring 1⅛ in. at the top. The movement of the deck at the face of the abutment was 2 in., indicating about 7/8 in. movement due to expansion. The wing walls were of a cellular type, the wells of which had not been filled, thus lightening the wall considerably. No provision for drainage of seepage water from behind the walls had been made, which resulted in their spreading about 3½ in. at the ends. The fact that the abutment walls were ½ in. out of plumb, that the crack of the wing walls at the approach wall was larger at the top than at the bottom, would indicate an overturning movement. The character of the foundation seemed to show that there had been no attempt to bed the bottom of the footing evenly in the shale.

The arch rings were cracked in several places. It was found that the crown of the arch was constructed with a 9-in. greater rise than was called for in the design.

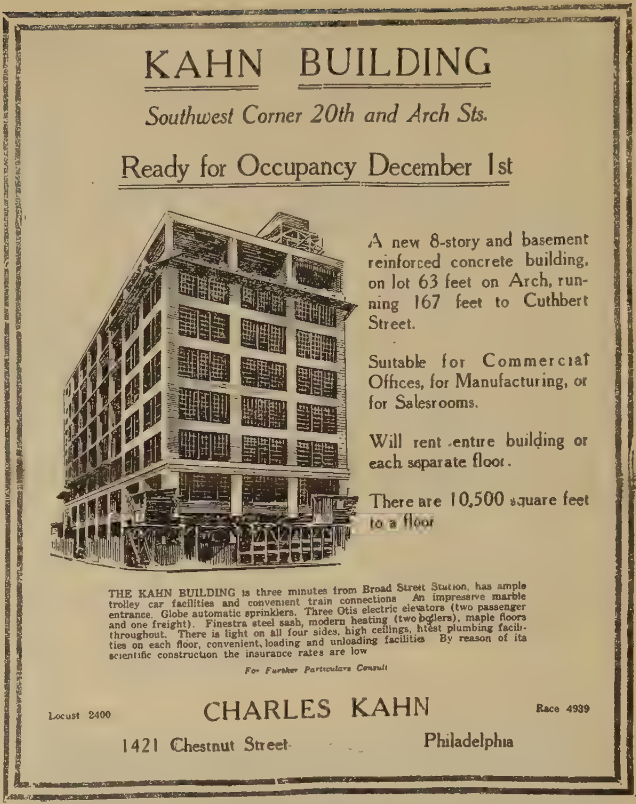
The roadway at the curb in the center of the span was humped 1½ in., which probably is the measure of the actual rise of the crown of the arch due to the shortening of the span.

The failure of the spandrel column, as shown in Fig. 2 and more strikingly in Fig. 3, was due to compression, though they were all out of plumb, due to a thrusting of the arch to the west and an expansion movement of the desk to the east. In warm weather all expansion joints were tight, and in the case of the expansion joints of the span in question, there was apparently nothing built but an ordinary construction joint, with no attempt at allowing a space for movement as the span elongated with warm weather.

The concrete of all but the rings was noticeably weak and faulty, and most of it had received a generous washcoat of grout to cover up its defects. Care was not used in depositing the concrete in the forms to prevent honeycomb, while the columns especially were lacking in mortar, due either to a mix lean in sand and cement, or more probably due to separation while chuting into place.

The details of the repairs were carried out under the direction of W. C. Reynolds and supervision of S. G. Gould, of Harrington, Howard and Ash, consulting engineers of Kansas City. The abutment wall was stabilized by the construction of large concrete buttresses as shown on Fig. 2. The shattered portions of the spandrel columns were replaced, supporting the deck on timbers which rested on the arch rings. The broken portions of the roadway and fascia beams and the sheared upper portion of the wing walls were also completely replaced, while seven steel-and-concrete ties were placed across the wing walls and approach walls to arrest further spreading. Future expansion was provided for by opening new expansion joints at each end of the span. Drainage holes were provided in the abutment wall to insure future drainage of this part of the structure. The empty wells of the cellular wing walls of the abutment were completely filled, and a new substantial sidewalk laid over them.

Oil lanterns, used on construction jobs to mark piles of material and dangerous places at night, frequently tip over and go out. This can practically be eliminated by casting a concrete block around the reservoir. A form of lumber, 8 in. square and about 4 in. deep, is made, a little concrete placed in the bottom, and the lamp centered on it, taking care that the filler cap is above the top of the form. The remainder of the form is filled with concrete, leaving the wick-adjusting screw accessible.—*Contractor's Atlas.*



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Race 4939

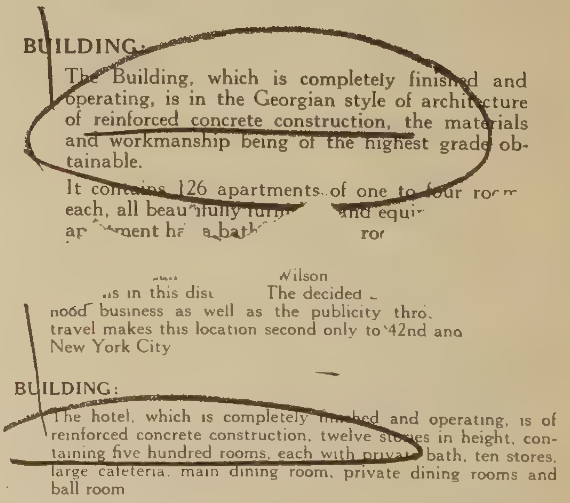
1421 Chestnut Street

Philadelphia

Fig. 1—Advertisement for Bond Sale on Reinforced Concrete Building

Selling Bonds for Concrete Buildings

The illustrations show some advertisements relating to the sale of bond issues on reinforced concrete buildings. Note the convincing sales talk possible in selling bonds on this type of construction. The advertisement of the Kahn Building is taken from the Philadelphia *Evening Ledger,* October 31, 1921. The clippings are taken from direct mail folders put out by the Fort Dearborn Trust and Savings Bank, Chicago, Ill.



BUILDING:

The Building, which is completely finished and operating, is in the Georgian style of architecture of reinforced concrete construction, the materials and workmanship being of the highest grade obtainable.

It contains 126 apartments of one to four rooms each, all beautifully furn and equi
ap ment ha a bath ro

Wilson
s in this dis The decided
hood business as well as the publicity thro
travel makes this location second only to 42nd and
New York City

BUILDING:

The hotel, which is completely finished and operating, is of reinforced concrete construction, twelve stories in height, containing five hundred rooms, each with private bath, ten stores, large cafeteria, main dining room, private dining rooms and ball room

Fig. 2—Clippings from Direct Mail Folders on Concrete Building Bond Issue

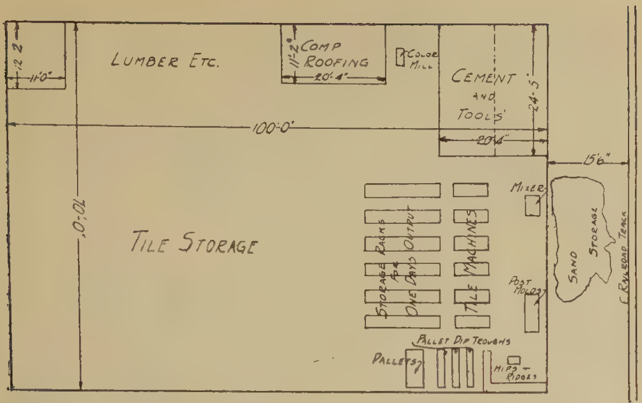


Fig. 1—Layout of Concrete Products Co.'s Plant

Roof Tile as Made and Laid in Birmingham, Ala.

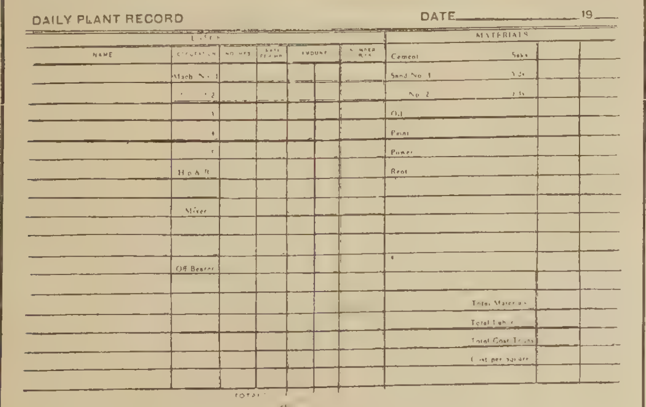
The plant of the Concrete Products Co., Birmingham, Ala., the layout of which is shown in the accompanying diagram, is equipped with six Walter roof tile and six Schieber[1] roof tile machines. These machines are placed side by side in pairs, one set only being used at a time. Beside each machine is a rack, holding ten tile, in which the tile are removed to the storage space.

When the tile makers start work, they remove the pallets from the tile made the previous day and dip them in oil. As the tile are made the filled pallets are placed in the rack and then removed to storage. In the afternoon the tile are inspected and the tile makers paid according to production. The tile are kept wet for ten days.

The foreman makes hips, ridges, finials, fence posts, etc., so that the mixer man is the only labor, besides the operators, that is required.

The company has reduced labor turnover by paying the men one cent per tile for the entire labor of making a tile, removing them to storage, and removing and dipping the pallets. Instead of doing all this themselves, they generally have their sons do the carrying. This work is done before and after school and doesn't take much of their time.

This company also applies concrete tile roofing as well as various composition roofings carried by them. They keep two outside gangs busy, one laying the composition roofing and "back grounds," while the second gang applies the tile. In this way the roofs are made waterproof as soon as the sheathing is on, even though the tile layers may not be able to get on the job for several days.



DAILY PLANT RECORD DATE ______ 19__

MATERIALS

NAME

Mach No. 1

H & R

Mixer

Off Bearer

TOTAL

Cement Sacks

Sand No. 1

No. 2

Oil

Paint

Power

Rent

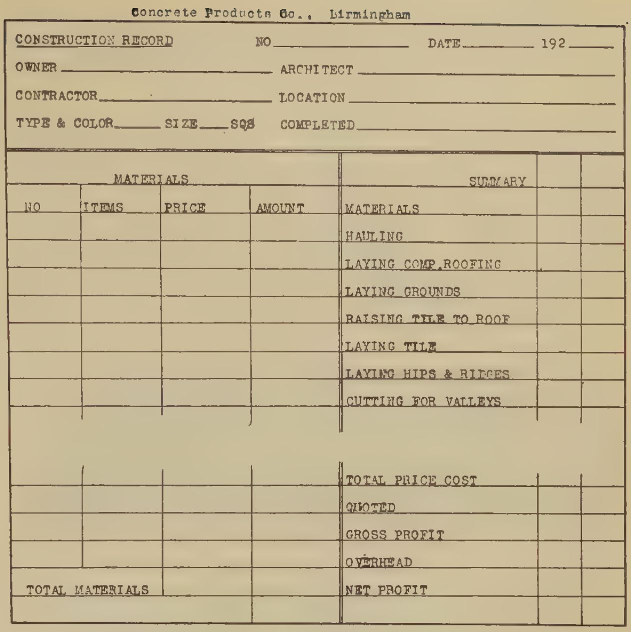
Total Materials

Total Labor

Total Cost

Cost per square

Fig. 3—Construction Cost Record



Concrete Products Co., Birmingham

CONSTRUCTION RECORD NO ______ DATE ______ 192__

OWNER ______ ARCHITECT ______

CONTRACTOR ______ LOCATION ______

TYPE & COLOR ______ SIZE ____ SQS COMPLETED ______

MATERIALS				SUMMARY		
NO	ITEMS	PRICE	AMOUNT	MATERIALS		
				HAULING		
				LAYING COMP. ROOFING		
				LAYING GROUNDS		
				RAISING TILE TO ROOF		
				LAYING TILE		
				LAYING HIPS & RIDGES		
				CUTTING FOR VALLEYS		
				TOTAL PRICE COST		
				QUOTED		
				GROSS PROFIT		
				OVERHEAD		
TOTAL MATERIALS				NET PROFIT		

Fig. 2—Plant Operation Cost Record

Fig. 2 shows a daily plant record slip 9½ in. by 6 in. that keeps the manufacturing costs tabulated. Fig. 3 is the cost record on an outside roofing job. It is mimeographed on a 8½ in. by 11 in. sheet. The other side of the sheet is used to itemize the hauling and labor charges.

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[1] Schieber Concrete Roof Tile Co., 2011 Hebert St., St. Louis, Mo.

Sprinkling System to Cure Pavement

The specifications for concrete pavement in the City of Seattle require the builder to cure the pavement for ten continuous days, including Sundays and holidays, either by an earth covering wetted down, by ponding, or continuous sprinkling.

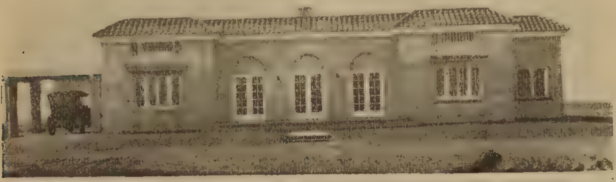
On a recent job, where the grades made ponding difficult and the earth covering was impractical for other reasons, J. L. Smith, contractor, laid pipe lines consisting of 20 ft. lengths of 1¼-in. pipe, coupled together with tees, into which a ½-in. nipple was screwed, holding a stationary brass cap known as a "Mutt" sprinkler attachment, and cured the pavement by sprinkling. Water is procured from city hydrants. One man's services are required during the day to watch the system. The concrete gang carried the connected pipe on to the previous day's work, which takes only a few minutes. On a smaller job 1-in. pipe was used, and an even smaller diameter might prove sufficient. Meters show that 41 cu. ft. of water is required to wet 100 sq. yds. per hour.

This method is very satisfactory to the municipal authorities, and is to be specified on all jobs in the future. It is economical and convenient for the contractor.—*Concrete Highway Magazine.*

Atlas Material Handling Equipment—Atlas Engineering Co., Milwaukee, Wis.: loose-leaf, 18 pp. and cover, 8½ x 11; describing and illustrating wagon and car loaders, belt and bucket conveyors, storage bins and revolving screens. It also contains a list of replacement parts and the company's private telegraphic code.

Progress in Use of Acme Wall System

The Acme system has been used in the construction of 17 buildings within a radius of 60 miles of Madera, Calif., its home, since it was last reported in CONCRETE for January, 1921. The system is in producing, in wood forms, two thin concrete shells, stiffened by studs cast as a unit with the shells and tied across a continuous air space by metal rods.



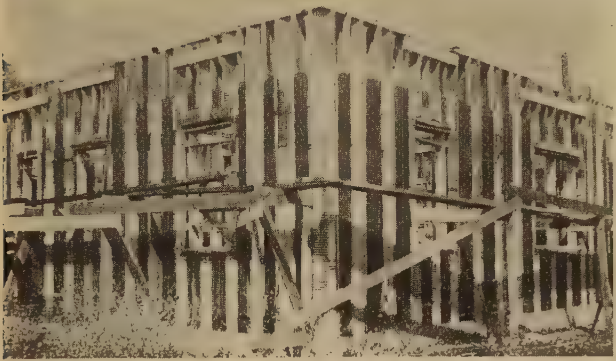


FIG. 1—HOUSE BUILT BY ACME SYSTEM NEAR FRESNO, CALIF.
FIG. 2—SHOWING STUDDING POURED BY THE ACME SYSTEM

Fig. 1 shows a house 50 ft. x 72 ft., recently built by this system on the highway between Madera and Fresno. This is the largest and most expensive house the company has built and is probably the most complete in all its appointments of any house in the county. The cost of the exterior walls made by the Acme system is reported as $600 less than the price for brick construction.

The saving over other forms of construction was so marked that J. R. Richardson, of the Acme Hollow Concrete Wall Co., feels sure that he can outbid brick. The company has not been forced, in the majority of cases, to bid against other forms of construction.

Fig. 2 shows the poured concrete studding on a house recently built in Los Angeles. No separate costs on exterior walls were kept. The cost of the house, which was 30 ft. x 32 ft., with five rooms and every modern convenience, including fireplace, buffet, oak floors, bath, toilet, lavatory, tile floor in bathroom, gas heater, gas in all rooms, plate glass mirrors in dressing room; garage, 12 ft. x 20 ft., with concrete walls and floor walks and driveway, is reported as $3,926.37. The company is well satisfied with the progress made in introducing the Acme system during the past year.

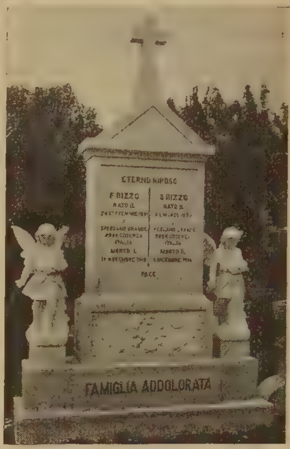
Ice Houses of Concrete Staves

An inquiry from a subscriber suggests that while we lack record of any ice houses built of concrete staves, there seems to be no drawbacks to the success of such a structure, using a double stave wall, if it is properly hooped and the dead air-space filled with saw-dust, flax straw, screened cinders or some other good packing material.

How Concrete Is Used in Monument

The illustration shows a tombstone constructed entirely of concrete, by Francis Mignone, a modeler of San Antonio, Texas, with portland cement and white marble chips. The surface is polished.

The cement used for the face mix is a half and half mixture of Atlas white and common gray portland cement. The facing of the monument is a mix of 1 part of this prepared cement to 2 parts white marble chips. The facing of the ornamental panel of the base and the panel on the gable is 1 part of Atlas white cement and 2 parts marble dust, pressed semi-wet in a one-piece plaster mold, the undercut being previously trimmed out. The figures are also faced with Atlas white cement and marble dust. The mix is pressed semi-wet in plaster piece molds.



CONCRETE MONUMENT AT SAN ANTONIO, TEXAS

The letters are incrusted ¼ in. deep with black marble chips and black colored cement. The letters are incrusted by filling the sunken letters to the surface from the mold in which the letters are raised and reversed.

The architectural parts are rubbed off with rubbing stone which gives a finish that is like granite.

The monument is 8 ft. 6 in. high. The base is 5 ft. wide and 16 in. thick. It is hollow and is formed, in the rough, of ordinary concrete.

Concrete Ships for the Russian Marine Reconstruction

The Swedish technical magazine *Skeppsbygnadskonst* has published the plans of the Russian engineer Jankow in Christiania, Norway, of a particularly well designed river boat for the Wolga and the connecting canal system.

This is designed to replace the entirely destroyed Russian fleet of river craft. The light draft required by these vessels has been met by increasing the unit value of concrete in compression and shear. Mr. Jankow considers the usual unit value in compression of 580 lbs. per sq. in. decidedly too small, as it is taken from considerations of structures in which the dead weight is of little importance.

He calculates his structure on the basis of 870 lbs. per sq. in. after three months, the values in shear, which according to Norwegian and Danish regulations are 1/10 of those in compression then become 8 7lbs. per sq. in.

For the reinforcing Mr. Jankow assumes 17,000 lbs. per sq. in. and 14,000 lbs. per sq. in. in shear.

On this basis Mr. Jankow designs his river boat 125 ft. long, 26 ft. 6 in. wide and 5 ft. 4 in. deep, and finds that for heavy loads it is equal to a steel vessel and cheaper both in first cost and in maintenance. The latter figures are taken from *Bayerisches Industrie und Gewerbeblatt* Nr. 51-52, 1921.

Cost Accounting in Products Manufacture —Second Article

By Mac Hanson

In the good times following the war, and prior to 1921, many a manufacturer got by and made lots of money without having any cost finding system worthy of the name. This was because his selling price advanced more than his cost price; because his volume of business was so greatly increased; because his turn-over was greater; or because his selling expense was less; and collections closer. One, or more, or all of these.

Good management wasn't so essential then. It was a seller's market. But in years like 1921 and 1922, when practically all of these things are reversed, good management is everything. And good management leans directly and heavily upon a good cost accounting system, that will give the manager an accurate record and a continuous history of every department, of every transaction of the business and clearly point out their relation to aiding or hindering the making of profit.

Every manufacturer must have an accurate cost accounting system under present conditions. There is no choice. If he had none before, let him now establish one. If he had one before, let him improve it. In either case, let him study his cost records, and especially the financial statements drawn from them, so that he may discover the causes that make for profit and those that make for losses, and be thus intelligently informed for his task of successfully managing his business.

In the first installment of this article we developed the accounting divisions used in this system of cost finding. They were Prime Cost, Cost of Production, and Cost of Goods Sold. We also discovered the first two principles—the most essential principles—of an accurate cost accounting system, viz., the cost estimate sheet and the actual expenses sheet. We discovered the part that the perpetual inventory played, and designed forms for it and the two sheets just mentioned. The "factory operation record" and "the invoice file" were found to be the principal sources of entries for posting to these three sheets.

In this installment we will present and discuss forms for the factory operation record, cost estimate sheets of manufacturing expenses, actual expenses sheets of manufacturing expenses, perpetual inventory of products manufactured, and related subjects.

As a basis of our discussion we will consider the costs of a factory manufacturing concrete farm drain tile in sizes from 5 in. to 12 in. internal diameters. This factory uses its own steam power, city light and water, commercial washed sand, the car system of handling products, steam curing, power mixer, power bucket elevator, power tile machine, and a 1 to 3 mix of concrete. It operates with four men on productive labor and a superintendent. It has, also, a general manager and an office clerk. The productive labor is distributed as follows: One man operates the mixer, feeding sand and cement, and regulating the water flow. He also fires the boiler. Two men operate the tile machine, feeding the concrete and stripping the tile on the triple-deck cars. They alternate on each deck. The fourth man yards the previous day's run, which requires about five hours of his time, after which he wheels sand from the outside storage pile to a point near the mixer. When not busy wheeling sand, he carries cement, which is in cloth bags, from the cement store room to the mixer, and thus gives some relief to the mixer man. The superintendent puts the loaded cars into the steam curing rooms, helps the yard man shove the loaded cars of cured tile out to the piles, cleans up around the tile machine, loads wagons, etc., and manages factory operations in general.

When outbound carloads of tile are shipped or inbound carloads of cement are received, factory operations are stopped and the four man crew does the labor of loading or unloading. When inbound carloads of coal or sand are received extra labor is hired at 20 cents a ton on coal and 15 cents a ton on sand. The owner is the general manager and looks after all office management, sales, promotional, advertising, and collection management, but devotes no chargeable time to superintendence of factory production.

Costs of sand, cement, and coal will be those given in Fig. 1 of the first installment of this article.[1] This gives us as simple and uncomplicated a manufacturing layout as will probably be met in actual experience, and yet be large enough to bring into play all the elements of cost accounting found in a concrete products plant.

The principal items chargeable to manufacturing expenses are fuel, water, lights, oil, telephone and telebuilding repairs, taxes, insurance, interest, depreciation on machinery, depreciation on buildings, culls and breakage, shortage and theft of finished products, supplies, service charges of various kinds, and general expense.

Now let us study these items of manufacturing expense and see if we can classify them in groups. Fuel, for power, will be used when the factory is operating, but not used when it is idle. Also, practically the same amount of fuel will be used each day, no matter whether a large or small volume of production is obtained. That is, about the same amount of fuel will be used in a day, whether we make 2,000 ft. of 5 in. tile, or make 3,000 ft. of 5-in. tile, that day. Fuel does not vary with the production. Water, lights, and oil are similar expenses. Let us call this type of expenses "Incidental Expenses."

Culls and breakage vary directly with the production. The more tile that are made in a day, the more chances for culls and breakage; the less tile made, the less chances for culls and breakage. In either case the percentage of culls, based on a hundred feet of production, may be the same, but the total amount of culls will vary directly with the volume of production.

Taxes on finished products, interest on money tied up in finished products, shortage and theft of finished products, are similar expenses. Let us call this type of expenses "variable expenses," because they vary with the volume of output. The variables are like the incidentals in that they occur when we are running, but do not occur when we are idle. They are different from the incidentals, in that they vary directly with the volume of production, while the incidentals do not so vary.

How about depreciation of machinery, depreciation of buildings, repairs to buildings, and interest on money invested in machinery and buildings? We find that we have these expenses no matter if we are operating or if we are idle. In this respect they are different from both the incidentals and the variables. We also find that they amount to a pretty well fixed amount each year,

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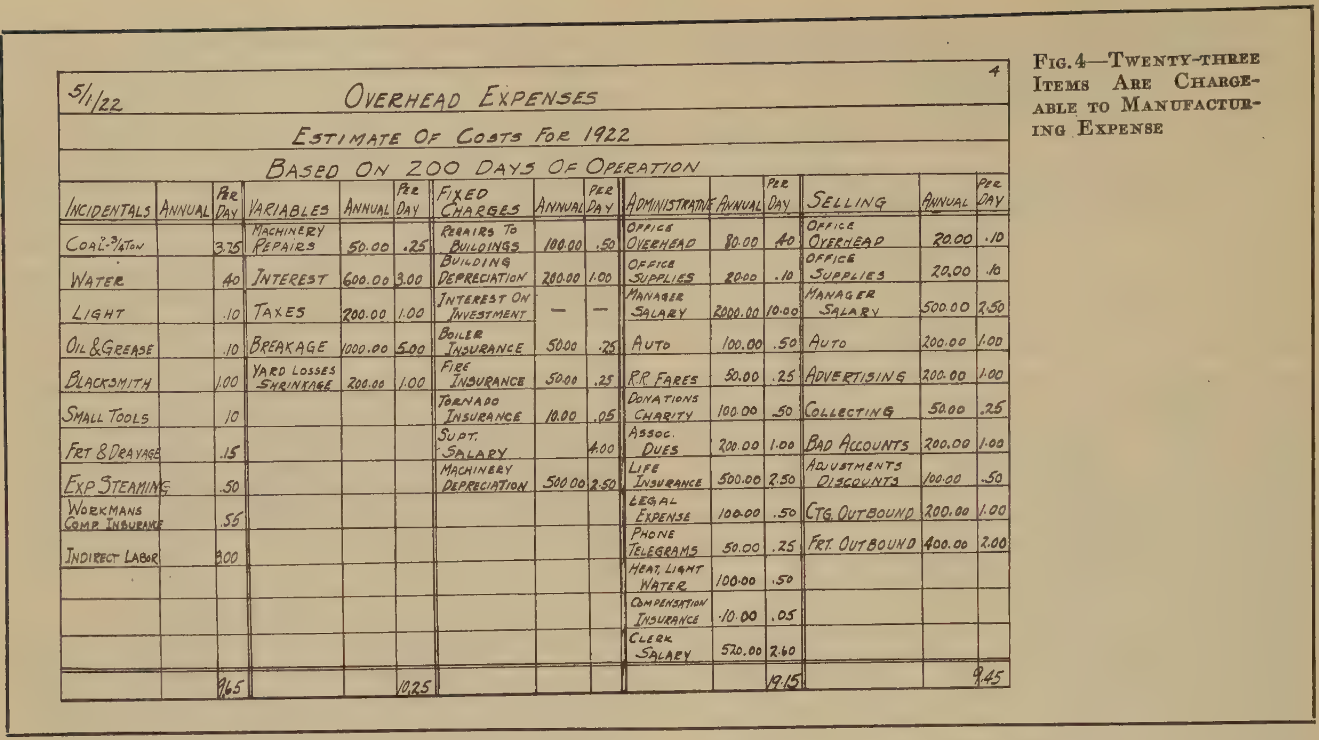
[1] See Concrete for June, 1922.



5/1/22 4

OVERHEAD EXPENSES

ESTIMATE OF COSTS FOR 1922

BASED ON 200 DAYS OF OPERATION

INCIDENTALS	ANNUAL	PER DAY	VARIABLES	ANNUAL	PER DAY	FIXED CHARGES	ANNUAL	PER DAY	ADMINISTRATIVE	ANNUAL	PER DAY	SELLING	ANNUAL	PER DAY
COAL?-3/4 TON		3.75	MACHINERY REPAIRS	50.00	.25	REPAIRS TO BUILDINGS	100.00	.50	OFFICE OVERHEAD	80.00	.40	OFFICE OVERHEAD	20.00	.10
WATER		.40	INTEREST	600.00	3.00	BUILDING DEPRECIATION	200.00	1.00	OFFICE SUPPLIES	20.00	.10	OFFICE SUPPLIES	20.00	.10
LIGHT		.10	TAXES	200.00	1.00	INTEREST ON INVESTMENT	—	—	MANAGER SALARY	2000.00	10.00	MANAGER SALARY	500.00	2.50
OIL & GREASE		.10	BREAKAGE	1000.00	5.00	BOILER INSURANCE	50.00	.25	AUTO	100.00	.50	AUTO	200.00	1.00
BLACKSMITH		1.00	YARD LOSSES SHRINKAGE	200.00	1.00	FIRE INSURANCE	50.00	.25	R.R. FARES	50.00	.25	ADVERTISING	200.00	1.00
SMALL TOOLS		.10				TORNADO INSURANCE	10.00	.05	DONATIONS CHARITY	100.00	.50	COLLECTING	50.00	.25
FRT & DRAYAGE		.15				SUPT. SALARY		4.00	ASSOC. DUES	200.00	1.00	BAD ACCOUNTS	200.00	1.00
EXP STEAMING		.50				MACHINERY DEPRECIATION	500.00	2.50	LIFE INSURANCE	500.00	2.50	ADJUSTMENTS DISCOUNTS	100.00	.50
WORKMANS COMP. INSURANCE		.55							LEGAL EXPENSE	100.00	.50	CTG. OUTBOUND	200.00	1.00
INDIRECT LABOR		3.00							PHONE TELEGRAMS	50.00	.25	FRT. OUTBOUND	400.00	2.00
									HEAT, LIGHT WATER	100.00	.50			
									COMPENSATION INSURANCE	10.00	.05			
									CLERK SALARY	520.00	2.60			
		9.65			10.25						19.15			9.45

FIG. 4—TWENTY-THREE ITEMS ARE CHARGEABLE TO MANUFACTURING EXPENSE

irrespective of the volume of production for that year. Therefore, let us call these items "fixed charges."

We now have our items of manufacturing expense classified under three headings. Let us now work out our "Cost Estimate Sheets" of manufacturing expenses (often called overhead expenses, or burden). By reference to Fig. 4 we see that there are 23 items of cost chargeable to manufacturing expense. (Since the forms and handling of administrative and of selling expense are similar to that of manufacturing expense, we will make no separate discussion and forms for them, but run them on to the forms for manufacturing expense. You will note that there are 13 items of expense under administrative expense, and 10 under selling expense.) But the amount of manufacturing expense incurred in any one day cannot be charged to the production of that day. Because, for example, repairs to buildings may all occur in one week of the year. Again, the machinery will probably be idle when it is being repaired, and there will be no production on those days.

Manufacturing expense must be estimated for the year, and these annual amounts distributed on some fair basis to the various items listed. The simplest basis is probably a distribution based on the average day's output for ten consecutive hours. Therefore, we must first determine what constitutes an average ten hour day's output of the various sizes of tile. From former records we find this to be as follows for the factory under consideration:

5 in. tile	3,000 ft.	8 in. tile	1,800 ft.
6 in. tile	2,500 ft.	10 in. tile	1,200 ft.
7 in. tile	2,200 ft.	12 in. tile	800 ft.

Next, we will have to estimate the probable volume of production of each size of tile for the year, before we can estimate what the total annual amount of manufacturing expense will be. From our general knowledge of the sales outlet, of the local condition of the trade, and from former records, we make the following estimate:

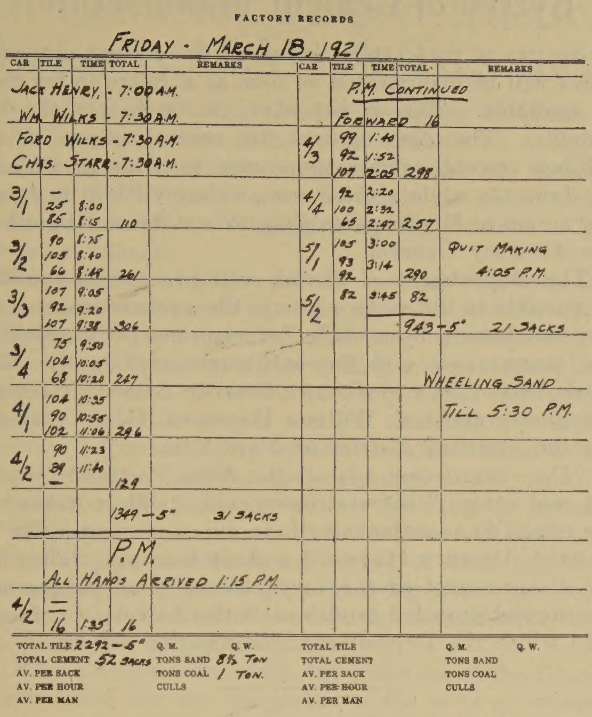
225,000 ft. of 5-in. equals	75 operating days
150,000 ft. of 6-in. equals	60 operating days
20,000 ft. of 7-in. equals	9 operating days
60,000 ft. of 8-in. equals	33 operating days
18,000 ft. of 10-in. equals	15 operating days
6,500 ft. of 12-in. equals	8 operating days
	200 operating days

From former records and experience we estimate the annual burden or manufacturing expense to be as indicated in the second column of each classification in Fig. 4, our overhead expenses estimate sheet. Since we base our calculations on 200 days of "standard day's output," the expense chargeable to each operating day will be 1/200 of the total expense for the year.

Right here let me make it plain that the term "operating day" does not mean merely ten hours of operating the machinery, but does mean the "standard output for ten hours," which we adopted as our average day's run. Hence our distribution is not determined on the basis of the calendar day, but upon the basis of a theoretical day, a "standard day's output," an average run. Therefore, practically, our distribution is not made on the basis of the day at all—it is made on the volume of production. And this is the fair way. For no two calendar days will show the same output in any one year, unless your men are working on a piece-work basis and are limited (or limit themselves) as to production for any one calendar day.

Consequently, on our basis of distributing manufacturing expense, if yesterday's run was only 2,000 ft. of 5-in., due to lots of grief, and today's is 3,000 ft., and tomorrow's will be 4,000 ft., due to exceptional freedom from trouble, then your charges for incidentals, for example, will be $\frac{2000}{3000}$ of \$9.65 for yesterday and $\frac{3000}{3000}$ of \$9.65 for today, and $\frac{4000}{3000}$ of \$9.65 for tomorrow. Likewise, for the variables and fixed charges. Thus each calendar day is charged according to its output, pro-rata to the "standard," or "average" day's output. The pro-rating should be approximated, not actual. This will save time and labor. Thus, a run of 1,857 ft. of 5-in. should be called 2/3 of a day's output. Likewise 2,141 ft. of 5-in., or 2,810 ft., should be called 3/3 of a day's output. Likewise, 3,192 ft. Such entries will average up very closely to the accurate figures over a period of several days.

Let us examine the items in Fig. 4. The first seven



FACTORY RECORDS

Friday - March 18, 1921

CAR	TILE	TIME	TOTAL	REMARKS	CAR	TILE	TIME	TOTAL	REMARKS
Jack Henry, - 7:00 A.M. Wm. Wilks - 7:30 A.M.						P.M. Continued Forward 16			
Ford Wilks - 7:30 A.M. Chas. Starr - 7:30 A.M.					4/3	99 92 107	1:40 1:52 2:05	298	
3/1	— 25 85	8:00 8:15	110		4/4	92 100 65	2:20 2:32 2:47	257	
3/2	90 105 66	8:25 8:40 8:49	261		5/1	105 93 92	3:00 3:14	290	Quit Making 4:05 P.M.
3/3	107 92 107	9:05 9:20 9:38	306		5/2	82	3:45	82 943 – 5"	21 Sacks
3/4	75 104 68	9:50 10:05 10:20	247						Wheeling Sand
4/1	104 90 102	10:35 10:55 11:06	296						Till 5:30 P.M.
4/2	90 39 —	11:23 11:40	129						
			1349 – 5"	31 Sacks					
	P.M. All Hands Arrived 1:15 P.M.								
4/2	— 16	1:35	16						

TOTAL TILE 2292 – 5" Q. M. Q. W.
TOTAL CEMENT 52 Sacks TONS SAND 8½ Ton
AV. PER SACK TONS COAL 1 Ton.
AV. PER HOUR CULLS
AV. PER MAN

TOTAL TILE Q. M. Q. W.
TOTAL CEMENT TONS SAND
AV. PER SACK TONS COAL
AV. PER HOUR CULLS
AV. PER MAN

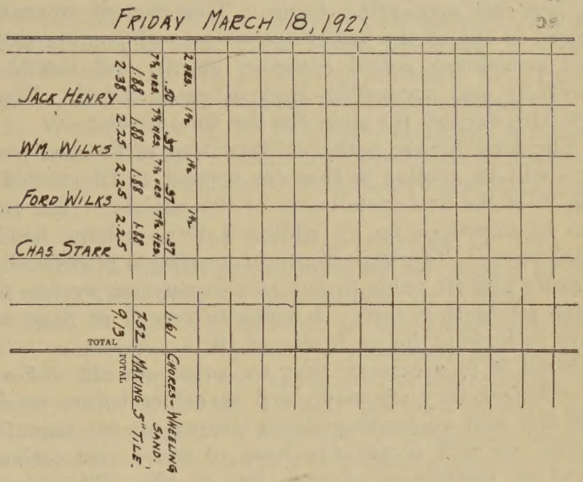
FIG. 5—FACTORY RECORDS

items of incidental expense are readily understood. The expenses of steaming products refers to the additional coal and labor used in banking the boiler fires for the night. Live steam is fed into the curing bins through a reducing valve at night. Exhaust steam is used in the day time. Chore (or indirect) labor refers to the expense incurred when your operating crew is taken away from producing in order to clean up the yard, to overhaul the decks, to straighten up the work-room, cut weeds, etc.

Under variable expenses, "culls and breaks" refers to that loss occurring in the process of manufacturing, curing and yarding. While "yard losses and shrinkage" will cover any further shortage found when a physical inventory is taken. All items under fixed charges are readily understood.

In order to gather the facts and data connected with the operation of the factory, some sort of record must be kept by the superintendent daily. This record we will call the "factory operation record." Since every factory must necessarily already have some such record, not much details will be given here. Such a record should show the name of each workman, his hours, and at what work he was employed; the size of tile made, amount of production, number of sacks of cement used, and number tons of sand used; it should also show the cause and length of time of delays, and other information useful to the general manager in guiding him in his policies.

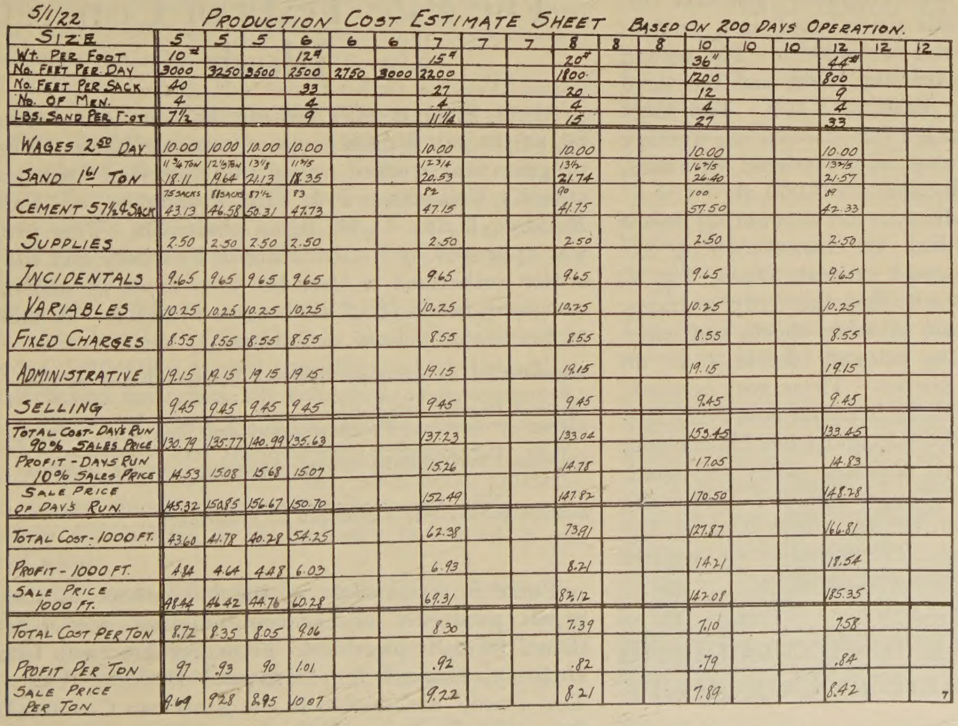
Forms for factory operation records are as varied as the number of factories. In Fig. 5 we give the front



Friday March 18, 1921

Jack Henry	2.38	7½ hrs. 1.88	2 hrs. .50
Wm. Wilks	2.25	7½ hrs. 1.88	1½ .37
Ford Wilks	2.25	7½ hrs. 1.88	1½ .37
Chas. Starr	2.25	7½ hrs. 1.88	1½ .37
TOTAL	9.13	7.52	1.61
	TOTAL	Making 5" Tile.	Chores - Wheeling Sand.

FIG. 6—TO FURNISH DATA FOR TIME SHEET



5/1/22 Production Cost Estimate Sheet Based On 200 Days Operation.

Size	5	5	5	6	6	6	7	7	7	8	8	8	10	10	10	12	12	12
Wt. Per Foot	10#			12#			15#			20#			36"			44#		
No. Feet Per Day	3000	3250	3500	2500	2750	3000	2200			1800			1200			800		
No. Feet Per Sack	40			33			27			20			12			9		
No. of Men.	4			4			4			4			4			4		
Lbs. Sand Per Foot	7½			9			11¼			15			27			33		
Wages 2.50 Day	10.00	10.00	10.00	10.00			10.00			10.00			10.00			10.00		
Sand 1.61 Ton	11¼ Ton 18.11	12⅕ Ton 19.64	13⅛ 21.13	11⅖ 18.35			12¾ 20.53			13½ 21.74			16⅖ 26.40			13⅖ 21.57		
Cement 57½¢ Sack	75 Sacks 43.13	81 Sacks 46.58	87½ 50.31	83 47.73			82 47.15			90 41.75			100 57.50			89 42.33		
Supplies	2.50	2.50	2.50	2.50			2.50			2.50			2.50			2.50		
Incidentals	9.65	9.65	9.65	9.65			9.65			9.65			9.65			9.65		
Variables	10.25	10.25	10.25	10.25			10.25			10.25			10.25			10.25		
Fixed Charges	8.55	8.55	8.55	8.55			8.55			8.55			8.55			8.55		
Administrative	19.15	19.15	19.15	19.15			19.15			19.15			19.15			19.15		
Selling	9.45	9.45	9.45	9.45			9.45			9.45			9.45			9.45		
Total Cost - Day's Run 90% Sales Price	130.79	135.77	140.99	135.63			137.23			133.04			153.45			133.45		
Profit - Days Run 10% Sales Price	14.53	15.08	15.68	15.07			15.26			14.78			17.05			14.83		
Sale Price of Day's Run.	145.32	150.85	156.67	150.70			152.49			147.82			170.50			148.28		
Total Cost - 1000 Ft.	43.60	41.78	40.28	54.25			62.38			73.91			127.87			166.81		
Profit - 1000 Ft.	4.84	4.64	4.48	6.03			6.93			8.21			14.21			18.54		
Sale Price 1000 Ft.	48.44	46.42	44.76	60.28			69.31			82.12			142.08			185.35		
Total Cost Per Ton	8.72	8.35	8.05	9.06			8.30			7.39			7.10			7.58		
Profit Per Ton	97	.93	90	1.01			.92			.82			.79			.84		
Sale Price Per Ton	9.69	9.28	8.95	10.07			9.22			8.21			7.89			8.42		7

FIG. 7—FINDING COST OF DAY'S RUN TO COMPARE WITH DAY'S OUTPUT

of such a record as filled in by the superintendent. The first column gives the bin number and car number; the second column gives the number of tile on each deck; the third gives the time of starting on each deck; the fourth the total number of tile on each car; and the last column gives general data, remarks, etc. Totals for the day are shown at the bottom of the sheet.

In Fig. 6 is shown the back of this same record as filled in by the clerk preparatory to entering the data on her cost accounting forms. This factory operation record is one of the important sources of posting to the cost accounting actual expenses sheets, and should be carefully and accurately kept in great detail. Fig. 6 will also furnish the data for the time sheet.

The form for the perpetual inventory of finished products will be similar to that for cement as illustrated in Fig. 3 of the first installment of this article. This form can be improved on by adding a third column headed "Balances." The importance of keeping a perpetual inventory and its value in any cost accounting system was fully set forth before. A separate record or page will have to be kept for each size of tile.

Since it is necessary that we price our tile for sale even before they are made, and therefore before we can run any cost accounting sheets proper on our manufacturing, we will necessarily have to run a cost estimate sheet on production of each size of tile. This should be done in a clear, logical, analytical method. In Fig. 7 we show such a form, which is self-explanatory. The item "Supplies" refers to rings, cheeks, and pallets for the tile machine—the wearing parts. "Supplies" is really a variable expense, but of such importance that we set it apart by itself.

The "Total Cost of a Day's Run" is first found. From this the "Total Cost per 1,000 ft." can be determined, or the "Total Cost per Ton," if desired, since you know the weights of your tile. This production cost estimate sheet is your guide until your cost accounting estimate sheets give you more reliable figures. The weights of sand per foot of tile, and the number of tile made from a sack of cement are shown in the heading of Fig. 7.

In this form we have shown three columns for each size of tile. Under the heading of 5-in. tile we have illustrated the use of these three columns. The first column is used to obtain the sale price based on a production of our standard day's run of 3,000 ft. The second column for 3,250 ft., standard day basis, and the third column for a standard day basis of 3,500. The sheet plainly shows that if a manager can increase his average production without increasing any overhead expenses, he can cut his cost of production per 1,000 ft.

We are now ready to discuss the accounting forms themselves, used in recording the manufacturing expenses. The overhead expenses estimate sheet, Fig. 4, is a lump sum estimate used to find the daily averages to use on the production cost estimate sheets and especially on the cost accounting estimate sheets, i. e., on the cost accounting forms proper. These cost accounting estimate sheets are the daily itemized cost records—the records which will tell the manager what his business is doing and guide him in his policies. They tell what, why and where things are happening, and enable the manager to keep his finger on the pulse beat of the entire business at all times. These and other matters will be discussed in the next installment.

Third Article on Cost Accounting in Products Manufacture in CONCRETE for August.

Retrial of Cement Manufacturers

Retrial of the eastern group of the cement anti-trust cases will be inaugurated as soon as a judge to try them is available. This is not likely to be before the fall months. The case against the central group in the alleged cement combination came to trial in Chicago on June 15, while a third case, on a civil bill, is awaiting action in Denver, according to a statement issued by the Attorney General.

The Department of Justice will proceed as speedily as possible in the eastern group, the announcement read, decision having been made for vigorous prosecution of the cement case and the anti-trust cases in the New York district, at a conference between Attorney General Daugherty and Col. William Hayward, U. S. Attorney for the southern district of New York.

"The cement case against the Atlas Portland Cement Co. and others," the statement said, "will be taken up for retrial in accordance with an announcement made by District Attorney Hayward a short time ago, following the disagreement of the jury. Scarcity of judges and the present crowded condition of the dockets is a factor with which the Department is obliged to reckon."

Multiple Cylinder Engines for Contracting

As further evidence of the increased interest in multiple-cylinder engines in the contracting field, announcement is made by the T. L. Smith Co., Milwaukee, that the Smith mixers are adapted for drive by and are now equipped with the LeRoi Power Unit, which may be fitted to the tilting mixer, sizes 10-S, 14-S, and 21-S, and on the 14-S and 21-S non-tilting mixers. The LeRoi unit is a fully equipped power plant consisting of a four-cylinder engine with radiator, magneto, carburetor, governor, fan and fan belt, fuel tank, air cleaner, and an automotive type of clutch. Weight, 850 lbs.

The Fire Tests of Concrete Block

About $700 is still lacking to complete a fund of $6,000 to pay for fire tests of concrete block. The test program was worked up by the American Concrete Institute's Committee P-5, Fire Resistance of Concrete Building Units, L. H. Allen chairman. This program was approved by the Institute in February and the committee authorized to have the tests made as soon as the necessary funds ($6,000) became available. A summary of funds available is as follows:

Appropriated by American Concrete Institute Board of Direction	$500
Portland Cement Association	2,500
Raised by Concrete Products Association individual subscriptions	2,145
Individual contributions through American Concrete Institute..	155
Total	$5,300
Balance needed before tests can be undertaken	700
	$6,000

There is no question of the importance of the tests to all producers of concrete building units. Checks should be made payable to Treasurer American Concrete Institute, marked for "Concrete Building Units Fire Test Fund," and mailed to the American Concrete Institute, 1807 East Grand Boulevard, Detroit Mich.

All Elements of Construction Industry to Work Together

A definite and comprehensive program designed to "put the construction industry as a whole on a higher plane and to determine ways and means of working together to that end" was adopted in an organization meeting June 20 at Washington by the American Construction Council.

The program of action for the ensuing year includes: the formation of a code of ethics acceptable to the whole industry and to the public; gathering of adequate statistics from all sources and resulting interpretation, having all the facts; reduction of the national shortage of building trades mechanics and the establishment of the necessary apprenticeship system; cooperation in establishing uniform building codes throughout the country; cooperation with the railroads in expediting the revision of existing freight rates on construction materials and the establishment and strengthening of local organizations throughout the country to bring about the cooperation of all elements of the industry in conformity with the principles of the Council.

Other matters with which the program of the Council is concerned are the mitigation of the evils of seasonal employment and trade migration of labor, the encouragement of local building shows, simplification in types of construction and sizes of materials, and elimination of waste, education of the public to the distribution of its construction and maintenance requirements more evenly throughout the year, the promotion of health and safety of workmen, the reduction of loss of life and waste of construction materials from preventable fires, the study of old buildings in order to establish superior methods of construction, and the education of the public as to the necessity and economy of properly maintaining structures.

The meeting of the Council was opened by Secretary of Commerce Hoover. Two hundred representatives of every element of the industry were in attendance, including architects, engineers, general contractors, sub-contractors, labor, manufacturers, dealers, bankers, insurance and bond interests, public utility corporations, state, federal, county and municipal construction departments. The sessions extended over June 19 and 20.

"If we would stem the tide tending to refer every little need and complaint to the Government, action to meet these demands must arise within the industry itself," declared Secretary Hoover. He stated that in bringing all representatives of the construction industry together for the purpose of organizing a national council the most important step in the history of the industry was being taken.

Among the subjects suggested by Secretary Hoover for the consideration of the Council were standardization of grades, inspection of and simplification of dimensions of construction materials, the collection of statistics, the encouragement of home building, zoning, proper building codes, seasonal and intermittent employment, jurisdictional disputes, apprenticeship, vocational training, and in general the elimination of unnecessary speculation and better functioning of the industry in regard to our national needs.

A warning against "an intense stratification of the various economic interests in our national life, which leads to selfish aims and purposes," was voiced by Willis H. Booth, vice-president of the Guaranty Trust Company of New York.

"If the public confidence is to be gained the aims and purposes of the Council must square," he said. "If we can surround the construction industry with a feeling of stability, we add immediately to its ability to secure credit. This feeling of stability is based on the confidence which the public gives to the construction industry."

Following the opening addresses short responses were made by Henry H. Kendall, architect, Boston; Thomas H. MacDonald, U. S. Bureau of Public Roads, Washington, D. C.; Calvert Townley, Westinghouse Electric & Manufacturing Co., New York; Frederick L. Cranford, Brooklyn; John R. Alpine, Grinnell Co., Providence; John Donlin, building trades department, A. F. of L., Washington; M. T. Bannigan, McQuade & Bannigan, Utica; William McClellan, McClellan & Junkersfeld, New York; and Ralph F. Proctor, Maryland Casualty Co., Baltimore.

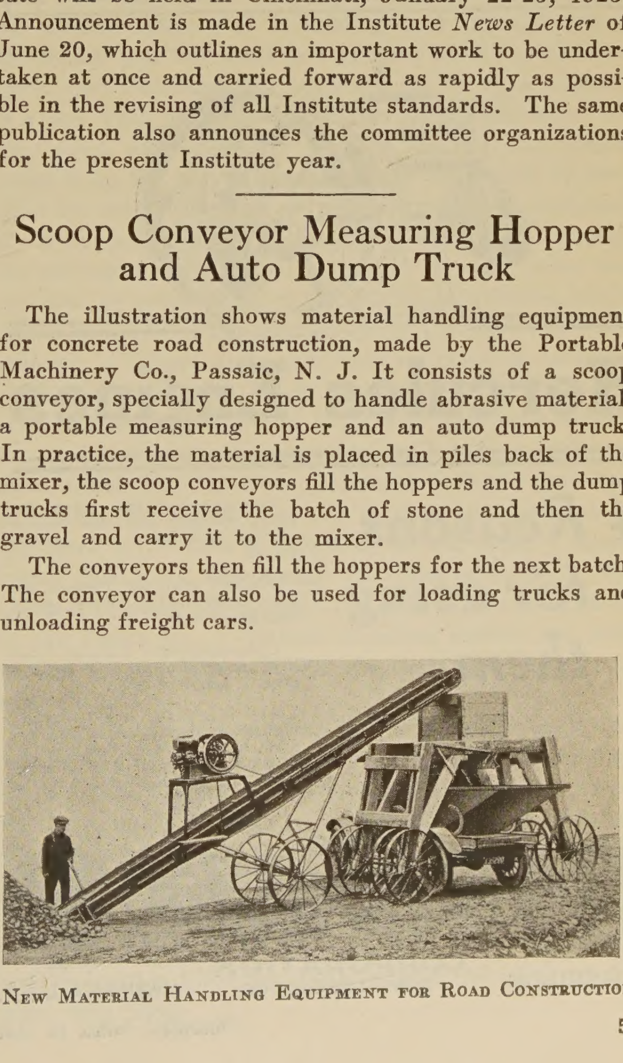
The afternoon and evening sessions on June 19 were devoted to the presentation of the report of the Operating Committee on Organization by General R. C. Marshall, Jr., general manager of the Associated General Contractors of America; a discussion of the proposed by-laws by the ten major groups representing the industry, into which the Council has been divided, and the election of officers. Franklin D. Roosevelt, Assistant Secretary of the Navy, was elected president of the Council, and John B. Larner, banker, of Washington, D. C., vice-president. The session on June 20 was devoted to a consideration of subjects to be taken up by the Council, and the adoption of an immediate program of action.

The next convention of the American Concrete Institute will be held in Cincinnati, January 22-25, 1923. Announcement is made in the Institute *News Letter* of June 20, which outlines an important work to be undertaken at once and carried forward as rapidly as possible in the revising of all Institute standards. The same publication also announces the committee organizations for the present Institute year.

Scoop Conveyor Measuring Hopper and Auto Dump Truck

The illustration shows material handling equipment for concrete road construction, made by the Portable Machinery Co., Passaic, N. J. It consists of a scoop conveyor, specially designed to handle abrasive material, a portable measuring hopper and an auto dump truck. In practice, the material is placed in piles back of the mixer, the scoop conveyors fill the hoppers and the dump trucks first receive the batch of stone and then the gravel and carry it to the mixer.

The conveyors then fill the hoppers for the next batch. The conveyor can also be used for loading trucks and unloading freight cars.



New Material Handling Equipment for Road Construction

Organizations

American Concrete Institute; Secretary, Harvey Whipple, 1807 East Grand Boulevard, Detroit. Convention, Cincinnati, Ohio, January 22-25, 1923.

American Concrete Pipe Association, M. W. Loving, Secretary, 111 West Washington St., Chicago.

Associated Metal Lath Manufacturers, Edison Bldg., Chicago; Wharton Clay, Commissioner.

Iowa Cement Stave Silo Association; H. E. Kilmer, Secretary, Oskaloosa, Ia.

Mid-West Concrete Products Assn., Frank Whipperman, Secretary-Treasurer, 3045 Fowler Bldg., Omaha, Neb.

National Crushed Stone Assn.; A. P. Sandles, Secretary, 405 Hartman Bldg., Columbus, Ohio.

National Housing Assn.; Lawrence Veiller, Secretary and Director, 105 East 22nd St., N. Y. C.

The National Lime Association; Mather Bldg., Washington, D. C.

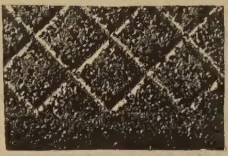
National Sand and Gravel Producers' Association; E. Guy Sutton, Secretary, Williamsport, Ind.

The National Concrete Stave Silo Asociation; W. G. Kaiser, Secretary, 111 West Washington St., Chicago.

Trade Publications

Insley Concrete Placing Equipment—Catalog No. 44 of the Insley Manufacturing Co., Indianapolis, Ind.; 8 in. x 11 in., 96 pp. and cover, illustrated. A well written and illustrated catalog that gives a good deal of valuable information on methods and equipment for placing concrete by gravity. All information required for designing and purchasing this equipment is included.

Excavating Equipment—Bulletin No. 57X, Pawling & Harnischfeger Co., Milwaukee, Wis., 8½ in. x 11 in., 34 pp. and cover, illustrated, describing caterpillar tread excavators, equipped with clam shell bucket, dragline bucket, orange-peel bucket, backfilling bucket, shovel attachment, skimmer scoop, crane hook, lifting magnet and pile-driving rig. Clearance diagrams and specification tables are given for all equipment, together with information on jobs where this equipment has been used. A good deal of information interesting to the excavating contractor is included.



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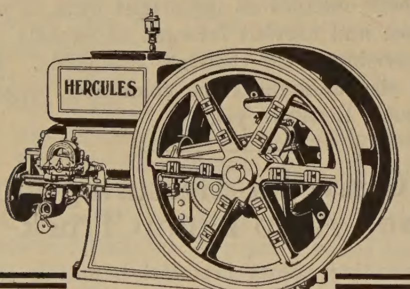

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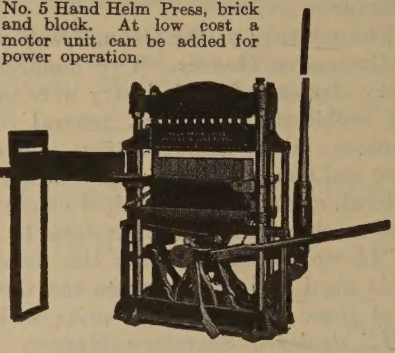

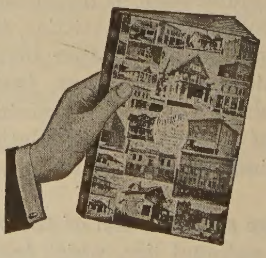

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